SAMPLING AND ANALYSIS PLAN/ QUALITY ASSURANCE PROJECT PLAN OPERABLE UNIT 3, LIBBY ASBESTOS SUPERFUND SITE

2012 Commercial Logging Activity-Based Sampling

Revision 0 – August 2012

Prepared by:

U.S. Environmental Protection Agency
Region 8
Denver, CO

With Technical Assistance from:

CDM Federal Programs Corporation
Denver, CO

This page intentionally left blank to facilitate double-sided printing

A1. TITLE AND APPROVAL SHEET

Libby OU3 Sampling and Analysis Plan/Quality Assurance Project Plan: 2012 Commercial Logging Activity-Based Sampling

REVISION LOG:

Revision #	Revision Date	Description
0	08/06/12	—

APPROVALS:

Christina Progess
EPA, Region 8, Remedial Project Manager, Libby OU3

8/6/12
Date

David L Berry

David Berry
EPA, Region 8, Human Health Risk Assessor

August 6, 2012
Date

Nathan Smith
CDM Smith, Project Manager

8/6/2012
Date

Terry Crowell
CDM Smith, Quality Assurance Manager

8/6/12
Date

This page intentionally left blank to facilitate double-sided printing

A2. TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

***The most recent versions of field SOPs, FSDSs, and COC forms are provided electronically in the OU3 eRoom (https://team.cdm.com/eRoom/mt/LibbyOU3). The most recent versions of laboratory and data verification SOPs are provided electronically in the Libby Lab eRoom (https://team.cdm.com/eRoom/mt/LibbyLab).*

LIST OF ACRONYMS AND ABBREVIATIONS

95UCL	95% Upper Confidence Limit
ABS	Activity-based Sampling
ACM	Asbestos Containing Material
AOC	Administrative Order on Consent
cc	cubic centimeters
CCI	Chapman Construction, Inc.
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHISQ	Chi-squared
CI	Confidence Interval
COC	Chain-of-Custody
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
EDS	energy dispersive spectroscopy
EDXA	Energy-dispersive X-ray
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
f/cc	fibers per cubic centimeter
FS	Feasibility Study
FSDS	Field Sample Data Sheets
FTL	Field Team Leader
GPS	Global Positioning System
HASP	Health and Safety Plan
HQ	Hazard Quotient
ID	identification
IDW	Investigation-derived Waste
ISO	International Organization for Standardization
IUR	Inhalation Unit Risk
KDC	Kootenai Development Corporation
L/min	liters per minute
LA	Libby amphibole
LC	laboratory coordinator
MCE	Mixed Cellulose Ester
MDEQ	Montana Department of Environmental Quality
mm	millimeter
MWH	MWH Americas, Inc.
N	number of asbestos fibers
NIST	National Institute of Standards and Technology

NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
OU	operable unit
OU3	Operable Unit 3
PCM	Phase Contrast Microscopy
PCME	Phase Contrast Microscopy Equivalent
pdf	portable document format
PLM	Polarized Light Microscopy
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QATS	Quality Assurance Technical Support
QC	Quality Control
RBC	Risk-Based Concentration
RfC	Reference Concentration
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROM	Record of Modification
RPM	Remedial Project Manager
SAED	Selected Area Electron Diffraction
SAP	Sampling and Analysis Plan
Site	Libby Asbestos Superfund Site
SOP	Standard Operating Procedure
SRM	standard reference material
STEL	Short Term Exposure Limit
TAS	Target Analytical Sensitivity
TEM	Transmission Electron Microscopy
TWA	Time Weighted Average
TWF	Time-Weighting Factor
µm	micrometer
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

A Project Management

A3. DISTRIBUTION LIST

This document describes data collection efforts that will be conducted during the remedial investigation (RI) for Operable Unit 3 (OU3) of the Libby Asbestos Superfund Site (the Site) to evaluate potential exposures to asbestos during commercial logging activities. This document contains the elements required for both a sampling and analysis plan (SAP) and quality assurance project plan (QAPP).

Copies of this completed/signed SAP/QAPP should be distributed to:

U.S. Environmental Protection Agency, Region VIII
1595 Wynkoop Street; 8EPR-SR
Denver, Colorado 80202-1129

- Victor Ketellapper (electronic copy)
- Christina Progess (2 hard copies, electronic copy)
- Deborah McKean (electronic copy)
- Don Goodrich (electronic copy)
- Elizabeth Fagen (electronic copy)
- David Berry (electronic copy)

Techlaw, Inc.
ESAT, Region VIII
16194 West 45th Drive
Golden, Colorado 80403

- Mark McDaniel (electronic copy)

Asbestos Laboratories
[to be determined]

Montana Department of Environmental Quality
1100 N Last Chance Gulch
Helena, Montana 59601

- John Podolinsky (electronic copy)

CDM Smith – Libby
60 Port Boulevard, Suite 201
Libby, Montana 59923

- Thomas Cook (electronic copy)

Remedium Group, Inc.
6401 Poplar Avenue, Suite 301
Memphis, TN 38119

- Robert Medler (1 hard copy; electronic copy)
- Robert Marriam (electronic copy)

MWH Americas, Inc
2890 E. Cottonwood Parkway, Suite 300
Salt Lake City, Utah 84121

- John Garr (1 hard copy; electronic copy)

Chapman Construction, Inc.
P.O. Box 516
Libby, Montana 59923

- Mike Chapman (1 hard copy; electronic copy)

Shaw Environmental & Infrastructure Group
20 George Street
Cambridge, Massachusetts 02140

- Mike Lenkauskas (electronic copy)

USFS - Northern Region
200 East Broadway
Missoula, Montana 59802

- Nancy Rusho (electronic copy)

A4. PROJECT TASK ORGANIZATION

Figure A-1 presents an organizational chart that shows lines of authority and reporting responsibilities for this project. The following sections summarize the entities and individuals that will be responsible for providing project management, SAP/QAPP development, field sampling support, on-site field coordination, analytical support, data management, and quality assurance for this project.

A4.1 Project Management

The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency for Superfund activities within OU3. The EPA Remedial Project Manager (RPM) for OU3 is Christina Progess, EPA Region 8. Ms. Progess is a principal data user and decision-maker for Superfund activities within OU3.

The US Forest Service (USFS) is the land management agency for over 20,000 acres within OU3. As such, the USFS is a support agency for this site. The USFS Project Coordinator is Nancy Rusho. The EPA will consult with the USFS while operating on USFS managed land.

The Montana Department of Environmental Quality (MDEQ) is the support regulatory agency for Superfund activities within OU3. The MDEQ Project Manager for OU3 is John Podolinsky. The EPA will consult with MDEQ as provided for by the Comprehensive Environmental

Response, Compensation, and Liability Act (CERCLA), the National Contingency Plan, and applicable guidance in conducting Superfund activities within OU3.

The EPA has entered into an Administrative Order on Consent (AOC) with Respondents W.R. Grace & Co.-Conn. and Kootenai Development Corporation (KDC) for performance of a Remedial Investigation/Feasibility Study (RI/FS) at OU3 of the Libby Asbestos Site. Under the terms of the AOC, W.R. Grace & Co.-Conn. and KDC will implement the activities described in this document, under EPA supervision. The designated Project Coordinator for Respondents W.R. Grace & Co.-Conn. and KDC is Robert Medler of Remedium Group, Inc. He is assisted by Robert Marriam of Remedium Group, Inc.

A4.2 SAP/QAPP Development

This SAP/QAPP was developed by CDM Federal Programs Corporation (CDM Smith) at the direction of, and with oversight by, the EPA. This SAP/QAPP contains all the elements required for both a field sampling plan and QAPP and has been developed in basic accordance with the *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA 2001) and the *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G4* (EPA 2006).

Copies of this SAP/QAPP will be distributed to the individuals above by CDM Smith, either in hard copy or in electronic format (as indicated in Section A3). The CDM Smith Project Manager (or their designate) is responsible for maintaining the SAP/QAPP and will distribute updated copies each time a document revision occurs. A copy of the final, signed SAP/QAPP (and any subsequent revisions) will also be posted to the OU3 website[1] and the OU3 eRoom[2].

A4.3 Field Sampling Support

All field collection activities described in this SAP/QAPP will be performed by W.R. Grace & Co.-Conn. and KDC and their contractors, in strict accordance with this SAP/QAPP. W.R. Grace & Co.-Conn. and KDC will be supported in this field work by MWH Americas, Inc. (MWH) and Chapman Constrution, Inc. (CCI). Individuals at CCI will be responsible for implementation of the commercial logging activities. Individuals at MWH will be responsible for supporting the collection of the air monitoring samples and environmental samples, and preparing the necessary field documentation for these samples.

- Project Manager: John Garr (MWH), Mike Chapman (CCI)
- Field Team Leaders: Kaitlin Barklow (MWH), Mike Chapman (CCI)
- Field Data Quality Control Officer: Betty Van Pelt (MWH)
- Quality Control Officer: Mike DeDen (MWH)

[1] http://cbec.srcinc.com/libby/
[2] https://team.cdm.com/eRoom/mt/LibbyOU3

A4.4 On-Site Field Coordination

Access to the mine and other areas of OU3 via Rainy Creek Road is currently restricted and is controlled by the EPA. The on-site point of contact for access to the mine is Rob Burton of Project Resources, Inc. and Environmental Restoration:

rob.burton@priworld.com
(406) 293-3690

A4.5 Analytical Support

All samples collected as part of this project for asbestos analysis will be sent for preparation and/or analysis to laboratories that meet the Libby-specific laboratory criteria that have been established for the project. These criteria are specified in **Appendix I**. Remedium may choose whether asbestos analytical laboratory services are procured directly or if services will be provided via the EPA.

A4.6 Data Management

Administration of the master database for OU3 will be performed by EPA contractors. The primary database administrator will be Lynn Woodbury of CDM Smith. She will be responsible for sample tracking, uploading new data, performing data verification and error checks to identify incorrect, inconsistent or missing data, and ensuring that all data are checked and corrected as needed. When the OU3 database has been populated, checked and validated, relevant asbestos data may be transferred into a Libby Asbestos Site database, as directed by the EPA for final storage.

A4.7 Quality Assurance

There is no individual designated as the EPA Quality Assurance Manager (QAM) for the Libby project. Rather, the Region 8 quality assurance (QA) program has delegated authority to the EPA RPMs. This means that the EPA RPMs have the ability to review and approve governing investigation documents developed by Site contractors. Thus, it is the responsibility of the EPA RPM for OU3, who is independent of the entities planning and obtaining the data, to ensure that this SAP/QAPP has been prepared in accordance with the EPA QA guidelines and requirements. The EPA RPM is also responsible for managing and overseeing all aspects of the quality assurance/quality control (QA/QC) program for OU3. In this regard, the EPA RPM is supported by the EPA Quality Assurance Technical Support (QATS) contractor, Shaw Environmental, Inc. The QATS contractor will evaluate and monitor QA/QC sampling and is responsible for performing annual audits of each analytical laboratory. In addition, HDR Engineering, Inc. has been contracted by the EPA to provide oversight of field sampling and data collection activities.

A5. PROBLEM DEFINITION/BACKGROUND

A5.1 Site Background

Libby is a community in northwestern Montana that is located near a large open-pit vermiculite mine. Vermiculite from the mine at Libby is known to be contaminated with amphibole asbestos that includes several different mineralogical classifications. For the purposes of the EPA investigations at the Libby Asbestos Superfund Site, this mixture is referred to as Libby amphibole (LA).

Historic mining, milling, and processing of vermiculite at the site are known to have caused releases of vermiculite and LA to the environment. Inhalation of LA associated with the vermiculite is known to have caused a range of adverse health effects in exposed humans, including workers at the mine and processing facilities (Amandus and Wheeler 1987, McDonald *et al.* 1986, McDonald *et al.* 2004, Sullivan 2007, Rohs *et al.* 2007), as well as residents of Libby (Peipins *et al.* 2003). Based on these adverse effects, the EPA listed the Libby Asbestos Superfund Site on the National Priorities List in October 2002.

Starting in 2000, the EPA began taking a range of cleanup actions at the site to eliminate sources of LA exposure to area residents and workers using CERCLA (or Superfund) authority. Given the size and complexity of the Site, the EPA designated a number of operable units (OUs). OU3 includes the property in and around the former vermiculite mine and the geographic area surrounding the mine that has been impacted by releases and subsequent migration of hazardous substances and/or pollutants or contaminants from the mine.

Figure A-2 shows the location of the mine and a preliminary study area boundary for OU3. The EPA established the preliminary study area boundary for the purpose of planning and developing the scope of the RI/FS for OU3. This study area boundary may be revised as data are obtained during the RI for OU3 on the nature and extent of environmental contamination associated with releases that may have occurred from the mine site. The final boundary of OU3 will be defined by the final EPA-approved RI/FS.

The EPA is concerned with environmental contamination in OU3 because the area could be used by humans for a variety of activities, including recreational activities (e.g., hiking), wood gathering by local residents, commercial logging, and, in the case of USFS employees, land management, and fire-fighting activities. The area is also habitat for a wide range of ecological receptors (both aquatic and terrestrial).

A5.2 Reasons for this Project

Historic releases of LA to the environment in OU3 have resulted in contamination of soil, tree bark, and duff (organic litter and debris on the forest floor) in the area surrounding the mine. Currently, there are no commercial logging operations planned within OU3. If logging operations were to occur in OU3, it is possible that LA structures in duff and tree bark may be released into the air, which could result in inhalation exposures to commercial logging crews. In addition, it is also possible that workers operating mill sites which process trees harvested from OU3 could also be exposed to LA due to contamination of the tree bark of harvested trees. Available data are not adequate to support reliable quantitative estimation of the air concentrations of asbestos fibers that may occur as a result of commercial logging operations in OU3. Thus, measured data are needed to provide information on potential inhalation exposures of LA to workers engaging in commercial logging activities in OU3.

A5.3 Applicable Criteria and Action Limits

At present, there are no criteria or action limits that apply specifically to LA exposures by workers or other individuals conducting logging and timber manufacturing operations. However, criteria for exposure of workers to asbestos in workplace air have been established by the Occupational Safety and Health Administration (OSHA). The short-term (15-minute) exposure limit (STEL) is 1.0 fiber per cubic centimeter of air (f/cc), and the long-term time-weighted average (TWA) exposure limit is 0.1 f/cc. Both exposure limits are expressed in terms of phase contrast microscopy (PCM) fibers (OSHA 2002), which does not distinguish between asbestos and non-asbestos fibers.

A6. PROJECT DESCRIPTION

A6.1 Project Summary

The purpose of this investigation is to collect air samples during commercial logging activities, referred to as "activity-based sampling" (ABS), which will provide measured data on potential exposures to LA. Basic tasks that are required to implement this investigation are described in greater detail in subsequent sections of this SAP/QAPP.

A6.2 Work Schedule

The timing of the ABS event has not yet been determined, but ABS should occur in the August-September 2012 timeframe in order to conduct activities in the driest part of the year. Once data are evaluated by the EPA risk assessment and project management teams, additional commercial logging ABS efforts may be conducted in the winter of 2012-2013, if it is deemed necessary to support risk management decision-making.

Based on the results of the commercial logging sampling effort in OU3, the EPA risk assessment and project management teams will make a determination if additional sampling efforts are necessary in other areas (e.g., OU4) to support risk-management decision-making. If additional sampling efforts are needed, investigation-specific SAP/QAPPs for these additional sampling efforts will be generated prior to sample collection.

A6.3 Location to be Studied

The location in OU3 where commercial logging activities will be performed is described in Section B1.1.

A6.4 Resources and Time Constraints

The greatest time constraint is that commercial logging activities must be conducted when conditions are dry and warm, and before rain and snow begin to occur in the fall. In addition, because commercial logging activities utilize specialized equipment, the timing of the sampling effort will be dictated by availability of commercial logging equipment and staff.

A7. QUALITY OBJECTIVES AND CRITERIA

A7.1 Data Quality Objectives

Data Quality Objectives (DQOs) are statements that define the type, quality, quantity, purpose, and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and the types of analyses to be performed. The EPA has developed a seven-step process for establishing DQOs to help ensure that data collected during a field sampling program will be adequate to support reliable site-specific risk management decision-making (EPA 2001, 2006).

Appendix A provides the detailed implementation of the seven-step DQO process associated with this SAP/QAPP.

A7.2 Performance Criteria

The range of LA concentrations that will occur in ABS air during commercial logging activities in OU3 is not known. However, it is possible to estimate the concentration levels that correspond to a level of human health concern. These calculations are provided in Section B4. The analytical requirements for LA measurements in ABS air as established in Section B4 ensure concentrations will be reliably detected and quantified if present at levels of concern.

Section D.3 provides additional information on how data users should perform a data usability assessment to ensure that data from this study are adequate with respect to the DQOs.

A7.3 Precision

The precision of asbestos measurements is determined mainly by the number (N) of asbestos fibers counted in each sample. The coefficient of variation resulting from random Poisson counting error is equal to $1/N^{0.5}$. In general, when good precision is needed, it is desirable to count a minimum of 3-10 fibers per sample, with counts of 20-25 fibers per sample being optimal to limit uncertainty due to analytic counting error.

Field duplicates of duff and tree bark samples will be collected (see Section B5.1.3). Analysis of these field duplicates will provide a measure of the precision of the sampling and analysis process. TEM recount, repreparation, and laboratory duplicate analyses will also be performed (see Section B5.2.3) to provide information on analysis reproducibility and precision.

A7.4 Bias/Accuracy and Representativeness

There is no established set of reference materials or spiked standards that can be used to assess accuracy of TEM analyses of LA in air, tree bark, or duff material.

It is expected that LA levels in ABS air may vary widely as a function of location, activities performed, and meteorological conditions. The ABS location selected for evaluation in this study is intended to represent the high-end of what may occur in OU3, so the measured levels of LA in ABS air may be biased high relative to other areas in the Libby Valley. ABS activities will be performed during the dry, summer months when the potential for LA release is likely to be highest, thus measured LA concentrations in ABS air may be biased high relative to exposures in other seasons. The ABS air sample collection will be performed under authentic commercial logging activities, not a set of scripted simulation scenarios, which ensures that results are representative of commercial logging exposures in OU3.

A7.5 Completeness

Target completeness for this project is 100%. If any samples of ABS air are not collected, or if LA analysis is not completed successfully, this could result in that portion of the study providing no useful information. In this event, additional sampling may be needed to support EPA risk management decision-making.

A7.6 Comparability

The data generated during this study will be obtained using sample collection, preparation, and analysis methods for measuring LA in air, tree bark, and duff material used previously at OU3.

The use of consistent methods will yield data that are comparable to previous results of LA analyses in air, tree bark, and duff material.

A7.7 Method Sensitivity

The method sensitivity (analytical sensitivity) needed for the analysis of LA in ABS air, tree bark, and duff material is discussed in Section B4.

A8. SPECIAL TRAINING/CERTIFICATIONS

A8.1 Field

Asbestos is a hazardous substance that can increase the risk of cancer and serious non-cancer effects in people who are exposed by inhalation. Therefore, all individuals involved in the collection, packaging, and shipment of samples must have OSHA 40-hour health and safety training, and respiratory protection training as required by 29 Code of Federal Regulations (CFR) 1910.134. Individuals must also have asbestos awareness training, as required by 29 CFR 1910.1001, as well as training in sample collection techniques and use of personal protective equipment. All training documentation will be stored in the appropriate field office. It is the responsibility of the field H&S manager to ensure that all training documentation is up-to-date and on-file for each field team member.

It is the responsibility of Remedium Group, Inc., or their contractors, to ensure that sampling is conducted in accordance with the project *Health and Safety Plan* (HASP) and to maintain appropriate documentation of training by active field personnel.

Prior to beginning field sampling activities, a field planning meeting will be conducted to discuss and clarify the following:

- Objectives and scope of the fieldwork
- Equipment and training needs
- Field operating procedures, schedules of events, and individual assignments
- Required quality control (QC) measures
- Health and safety requirements

It is the responsibility of each field team member to review and understand all applicable governing documents associated with this sampling program.

During the ABS event, radio communication shall be used by field personnel to conduct flow checks, media change outs, and to communicate with all personnel prior to entering a scenario location for safety reasons.

A8.2 Laboratory

A8.2.1 Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Each laboratory is accredited by the National Institute of Standards and Technology (NIST) and National Voluntary Laboratory Accreditation Program (NVLAP) for the analysis of airborne asbestos by transmission electron microscopy (TEM). This includes the analysis of NIST/NVLAP standard reference materials (SRMs), or other verified quantitative standards, and successful participation in two proficiency rounds per year of airborne asbestos by TEM supplied by NIST/NVLAP.

Copies of recent proficiency examinations from NVLAP or an equivalent program, as well as certifications from other state and local agencies, are maintained by each participating analytical laboratory. Copies of all proficiency examinations and certifications are also maintained by the laboratory coordinator (LC) (Remedium Group, Inc.).

Each laboratory working on the Libby project is also required to pass an on-site EPA laboratory audit. The details of this EPA audit are discussed in Section C1.1.2. The LC also reserves the right to conduct any additional investigations deemed necessary to determine the ability of each laboratory to perform the work. Each laboratory also maintains appropriate certifications from the state and possibly other certifying bodies for methods and parameters that may also be of interest to the Libby project. These certifications require that each laboratory has all applicable state licenses and employs only qualified personnel. Laboratory personnel working on the Libby project are reviewed for requisite experience and technical competence to perform asbestos analyses. Copies of personnel resumes are maintained for each participating laboratory by the LC in the Libby project file.

A8.2.2 Laboratory Team Training/Mentoring Program

Initial Mentoring

The orientation program to help new laboratories gain the skills needed to perform reliable analyses at the Site involves successful completion of a training/mentoring program that was developed for new laboratories prior to their analysis of Libby field samples. All new laboratories are required to participate in this program. The program includes training provided by the QATS contractor and/or senior personnel from other Libby team laboratories. The training/mentoring process includes a review of morphological, optical, chemical, and electron diffraction characteristics of LA, as well as training on project-specific analytical methodology, documentation, and administrative procedures used on the Libby site. The mentoring process also includes a general EPA audit, which is performed by the QATS contractor, to determine the general capabilities of the laboratory, the adequacy of facilities and instrumentation, and evaluate of the laboratory quality management system. The mentor will also review the analysis of at least one proficiency demonstration sample for each analytical method with the trainee laboratory.

Once the laboratory has satisfactorily completed the training/mentoring program, they can begin to support the analysis of Libby field samples. Initially, all submitted analytical results will undergo a detailed data verification and validation review (see Section D2). The frequency of these reviews can be reduced if no issues are identified. The QATS contractor may also perform a subsequent EPA audit to evaluate analyses of Libby field samples.

Site-Specific Reference Materials

Because LA is not a common form of asbestos, the U.S. Geological Survey (USGS) prepared site-specific reference materials using LA collected at the Libby mine site (EPA 2008a). Upon entry into the Libby program, each laboratory is provided samples of these LA reference materials. Each laboratory is required to analyze multiple LA structures present in these samples by TEM in order to become familiar with the physical and chemical appearance of LA and to establish a reference library of LA energy dispersive spectroscopy (EDS) spectra. These laboratory-specific and instrument-specific LA reference spectra (EPA 2008b) serve to guide the classification of asbestos structures observed in Libby field samples during TEM analysis.

Regular Technical Discussions

On-going training and communication is an essential component of QA for the Libby project. To ensure that all laboratories are aware of any technical or procedural issues that may arise, a regular teleconference is held between the EPA, their contractors, and each of the participating laboratories. Other experts (e.g., USGS) are invited to participate when needed. These calls cover all aspects of the analytical process, including sample flow, information processing, technical issues, analytical method procedures and development, documentation issues, project-specific laboratory modifications, and pertinent asbestos publications.

Professional/Technical Meetings

Another important aspect of laboratory team training has been the participation in technical conferences. The first of these technical conferences was hosted by USGS in Denver, Colorado, in February 2001, and was followed by another held in December 2002. The Libby laboratory team has also convened on multiple occasions at the Johnson Conference in Burlington, Vermont, including in July 2002, July 2005, July 2008, and July 2011, and at the Michael E. Beard Asbestos Conference in San Antonio, Texas in January 2010. In addition, members of the Libby laboratory team attended an EPA workshop to develop a method to determine whether LA is present in a sample of vermiculite attic insulation held in February 2004 in Alexandria, Virginia.

These conferences enable the Libby laboratory and technical team members to have an on-going exchange of information regarding all analytical and technical aspects of the project, including the benefits of learning about developments by others.

A8.2.3 Analyst Training

All TEM analysts for the Libby project undergo extensive training to understand TEM theory and the application of standard laboratory procedures and methodologies. The training is typically performed by a combination of personnel, including the laboratory manager, the laboratory QAM, and senior TEM analysts.

In addition to the standard TEM training requirements, trainees involved with the Libby project must familiarize themselves with Site-specific method deviations, project-specific documents, and visual references. Standard samples that are often used during TEM training include known pure (traceable) samples of chrysotile, amosite, crocidolite, tremolite, actinolite and anthophyllite, as well as fibrous non-asbestos minerals such as vermiculite, gypsum, antigorite, kaolinite, and sepiolite. New TEM analysts on the Libby project are also required to perform an *EDS Spectra Characterization Study* (EPA 2008b) on the LA-specific reference materials provided during the initial training program to aide in LA mineralogy recognition and definition. Satisfactory completion of each of these tasks must be approved by a senior TEM analyst.

All TEM analysts are also trained in the Site-specific laboratory QA/QC program requirements for TEM (see Section B5.2.3). The entire program is discussed to ensure understanding of requirements and responsibilities. In addition, analysts are trained in the project-specific reporting requirements and data reporting tools utilized in transmitting results. Upon completion of training, the TEM analyst is enrolled as an active participant in the Libby laboratory program.

A training checklist or logbook is used to assure that the analyst has satisfactorily completed each specific training requirement. It is the responsibility of the laboratory QAM to ensure that all TEM analysts have completed the required training requirements.

A9. DOCUMENTATION AND RECORDS

A9.1 Field Documentation

Field teams will record sample information on the most current version of the Site-specific field sample data sheets (FSDSs) developed for ABS air, tree bark, and duff materials[3]. Section B3.1 provides detailed information on the sample documentation requirements for samples collected as part of this study. In brief, the FSDS forms document the unique sample identification (ID)

[3] The most recent versions of these FSDS form templates are available in the OU3 eRoom.

number assigned to every sample collected as part of this program. In addition, the FSDSs provide information on whether the sample is representative of a field sample or a field-based QC sample (e.g., field blank, field duplicate). The field teams will also record information related to sample collection in a field logbook.

A9.2 Laboratory

All analytical data for asbestos generated in the analytical laboratory will be documented on Site-specific laboratory bench sheets. Section B4.2 provides detailed information on the requirements for laboratory documentation and records. In brief, the data recorded on the bench sheets are entered into a Site-specific electronic data deliverable (EDD) template spreadsheet developed for recording TEM results for ABS air, tree bark, and duff[4]. It is the responsibility of each laboratory to maintain logbooks and other internal records throughout the sample lifespan as a record of sample handling procedures. Upon completion of the appropriate analyses, the EDD spreadsheets, along with scanned copies of all analytical laboratory data packages, will be posted to the OU3 eRoom.

A9.3 Record of Modification

It is the also responsibility of the field team and laboratory staff to maintain logbooks and other internal records throughout the sample lifespan as a record of sample handling procedures. Significant deviations (i.e., those that impact or have the potential to impact investigation objectives) from this SAP/QAPP, or any procedures referenced herein governing sample handling, will be discussed with the EPA RPM (or their designate) and CDM Smith Project Manager prior to implementation. Such deviations will be recorded on a Record of Modification (ROM) form. Sections B5.1.2 and B5.2.2 provide detailed information on the procedures for preparing and submitting ROMs by field and analytical laboratory personnel, respectively.

[4] The most recent version of the TEM EDDs are provided in the OU3 eRoom.

B Data Generation and Acquisition

B1. STUDY DESIGN

B1.1 Sampling Location

Available data on levels of LA measured in tree bark, soil and duff indicate that, in general, the levels of LA tend to decrease with distance away from the center of the mine. Therefore, the approach that will be taken at OU3 for the commercial logging effort is to collect ABS samples in an area that is representative of high potential LA exposure (e.g., in an area of OU3 that is predominantly downwind from the mine where high concentrations of LA have been reported in tree bark and duff) and to assume that the risks calculated at this location are equal to or greater than the risks at equal distances from the mine in the crosswind and upwind directions and at distances that are further from the mine. This approach will help ensure that assumed risks at other OU3 locations are more likely to be overestimated than underestimated. Based on this approach, **Figure B-1** presents the general area identified for conducting commercial logging activities (see red polygon). The actual location selected within this area will depend upon the ease of access and availability of trees for harvesting. In general, 100 trees of appropriate size will be selected for harvest to conduct hand-felling operations. The selected logging area should be large enough such that it would take 1-2 days to complete hand-felling operations.

As noted previously, if deemed to be needed to support risk management decisions, additional ABS at locations with lower potential LA exposures may be evaluated in the future. If any additional sampling efforts are needed, investigation-specific SAP/QAPPs for these efforts will be generated prior to sample collection.

B1.2 Tree Bark and Duff Material Sample Collection

Once a logging ABS area has been identified, samples of tree bark and duff material within the area will be collected and analyzed for LA by TEM to ensure that measured concentrations are similar to the high-end range levels measured during the earlier duff/tree bark sampling efforts in 2007. ABS should not be conducted until the results of the duff and tree bark samples are available.

A total of 25 different trees from within the ABS area will be selected for sampling. The selected trees should be spatially representative of the entire ABS area, and selected from standing trees that are from the lot of trees that will be felled as part of the hand-felling ABS scenario. From the 25 selected trees, 5 composite bark samples will be collected.

At each tree selected for bark sampling, a multi-point composite sample of duff material will also be collected. From the 25 trees selected, 5 composite duff samples will be collected.

B1.3 ABS Activity Scripts

Commercial logging operations can encompass a variety of different activities. Unlike other ABS investigations, which tend to utilize precise scripts that dictate the types and durations of each activity, for this effort, the scripts will be flexible, and ABS will be performed under authentic conditions[5] by field personnel who are familiar and experienced with these types of activities and equipment.

The following types of activities are expected to be evaluated as part of this sampling effort:

Hand-Felling - The felling of timber is the process of severing the tree from the stump and placing it on the ground. Hand-felling is the traditional method of skilled personnel, herein referred to as a sawyer, utilizing a handheld chain saw to cut the timber. This method employs techniques and skills to complete a face cut and undercut to control the direction and rate of fall to the tree.

Skidding of Timber - The skidding of timber is the process of moving trees which have been felled to a centralized location for further processing or transportation. A skidder transports trees by dragging them on the ground. Skidders can be open or closed cab machines and can utilize cables (which are attached to felled trees) or grapples (which grab felled trees) to move trees to a processing area. The cable skidder, which requires an operator to get off the machine to manually attach trees with cables (or chokers), has been identified as being the most practical method for the skidding scenario. The activity of attaching chokers to logs is commonly referred to as “hooking”. Utilizing the cable skidder scenario for this investigation allows for data to be captured during both skidding and hooking operations.

Mechanical Processing - Timber processing is the act of cutting limbs from the tree and cutting the tree into the desired length and width. Although mechanical processors vary, most utilize an excavator-type machine that mechanically strips limbs from the tree and cuts the tree into desired lengths. Mechanical processors most often have enclosed cabs in which the operator is stationed through the duration of processing activities. Mechanical processing has been identified as being the most commonly utilized method to process timber within the Libby Valley. For this scenario, an enclosed cab mechanical processor will be utilized.

Milling Process – The milling process is the act of removing bark from cut timber and cutting logs to appropriate size and shape for sale. This activity is commonly done at a mill site; however, for this event logs will be cut into slabs and run through a chipper to simulate de-barking activities.

[5] Field personnel will perform activities while in the appropriate PPE, which is required for all activities in OU3.

Site Preparation for Re-planting - Following harvesting operations, the site must be prepared for replanting. Site preparation typically takes place in the summer and fall and planting takes place in the spring. This ABS event will not include a replanting component. For this scenario, mechanical preparation will be done utilizing a bulldozer or excavator to remove brush and tree litter from the area. This process will continue until the landing area has been cleared and the road restored to its original condition. Mechanical preparation has been identified as being the most commonly utilized method to prepare sites within the Libby Valley.

Appendix B provides the ABS script for each type of activity that will be evaluated in this commercial logging study. In brief, personal air monitoring samples will be collected for sawyers and skidder operators, with sampling pumps placed near the breathing zone of the individual (i.e., on shoulder). For individuals that operate mechanical processing machinery or bulldozers/excavators, sampling pumps may either be worn by the individual or placed in the machine cab. In addition, stationary monitors will be placed near the milling location and on the perimeter of the logging area to provide information on air concentrations near milling activities (e.g., to nearby workers), as well as the potential for contamination migration outside of the logging area.

There is no pre-established study duration or sample numbers for this study. Rather, the number of ABS air samples collected will depend upon the number of individual workers participating in the types of commercial logging operations described above and how long it takes to complete logging operations for the selected ABS area. ABS air samples will be collected for each individual worker over the entire duration of logging operations.

B1.4 Study Variables

The level of LA in ABS air under source disturbance activities can depend on factors that vary seasonally (e.g., soil moisture, wind speed, humidity, etc.). ABS should be performed under conditions that have a high probability of resulting in measureable ABS air concentrations of LA.

To ensure that sampling conditions are generally favorable towards the release of LA fibers, ABS will be restricted to summer months (August-September) when rainfall and soil moisture levels are at their lowest. ABS will not occur if rainfall in the past 36 hours has exceeded ¼ inch, or if there is standing water present.

B1.5 Critical Measurements

The critical measurements for this project are measurements of the concentration of LA in ABS air during commercial logging operations in OU3 at a location that is expected to have high-end levels of LA contamination in source materials (i.e., duff, soil, tree bark). The analysis of LA may be achieved using several different types of microscopes, but the EPA generally recommends using TEM because this analytical method has the ability to clearly distinguish asbestos from non-asbestos structures, and to classify different types of asbestos (i.e., LA, chrysotile). In addition, analysis by TEM provides structure-specific dimensions that allow for the estimation of PCM-equivalent[6] (PCME) concentrations, which is the concentration metric necessary to estimate exposure and risks. Thus, all analyses for this study will be performed by TEM.

B1.6 Data Reduction and Interpretation

ABS air samples collected in the field will be used to prepare grids for TEM examination (see Section B4). From this examination, the total number of PCME LA structures observed is recorded and the ABS air concentration is calculated as follows:

$$Cair = (N \cdot EFA) / (GOx \cdot Ago \cdot V \cdot 1000 \cdot f)$$

where:

Cair	=	Air concentration (structures per cubic centimeter [s/cc])
N	=	Number of PCME LA structures observed (structures)
EFA	=	Effective filter area (mm^2)
GOx	=	Number of grid openings examined
Ago	=	Area of a grid opening (mm^2)
V	=	Sample air volume (L)
1000	=	L/cc (conversion factor in liters per cubic centimeter)
f	=	Indirect preparation dilution factor (assumed to be 1 for direct preparation)

Data for PCME LA concentrations in ABS air will be used to evaluate potential human health risks from commercial logging exposures in OU3.

B2. SAMPLING METHODS

B2.1 Tree Bark Sample Collection

Tree bark samples will be collected, handled, and documented in general accordance with standard operating procedure (SOP) EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix C**), with the following project modifications:

- Trees selected for sampling will be Douglas fir with a diameter (caliper) of at least 8 inches. If these trees are not available within the ABS area, trees with a large diameter and rough bark will be selected preferentially.

[6] PCME structures have a length greater than 5 microns (µm), width greater than or equal to 0.25 µm, and aspect ratio greater than or equal to 3:1.

- It is not anticipated that the same tree will need to be located for future sampling activities, so flagging tape/ID tags will not be left on the tree. Global positioning system (GPS) coordinates will be collected for each tree location.
- Tree bark samples will consist of a 5-tree composite. Decontamination or use of new equipment will not be necessary between trees that are combined into the same 5-tree composite sample.

In brief, a hole saw will be used to collect a circular bark sample for analysis of LA by TEM. The collection of tree age cores is not necessary for this project.

B2.2 Duff Material Sample Collection

At each tree selected for bark sampling, a composite sample of duff material will be collected, handled, and documented in general accordance with SOP EPA-LIBBY-2012-11, *Sampling and Analysis of Duff for Asbestos* (see **Appendix C**), with the following project modifications:

- One grab sample from a 5-foot radius next to each tree selected for bark sampling will be collected to make up a 5-point composite sample of duff material. Enough duff material will be collected from each sub-location such that the composite sample fills a one-gallon zip-top bag.

In brief, at each specified sampling point, any fresh or partially decayed organic debris (e.g., twigs, leaves, pine needles) will be collected by hand from the soil surface, taking care to ensure that the top layer of soil beneath the organic debris is not included in the duff material sample.

B2.3 ABS Air Sample Collection

ABS air samples will be collected, handled, and documented in basic accordance with the procedures specified in OU3-specific SOP ABS-LIBBY-OU3, *Activity-based Sampling for Asbestos*, (see **Appendix C**). In brief, a battery-powered air sampling pump (SKC model AirChek XR5000 ™ [0.005-5.0 L/min] or similar) will be worn by the ABS participant, affixed to the interior cab of the logging equipment, or set on stationary stands around perimeter of activities. The monitoring cassette will be attached to the pump via a plastic tube, and affixed such that the cassette is within the breathing zone. All air samples will be collected using cassettes that contain a 25-mm diameter mixed cellulose ester (MCE) filter with a pore size of 0.8 µm.

During the ABS activity, two different sampling pumps will be worn by the worker (or placed in the machine cab or on stationary stands) – a high volume pump and a low volume pump – to allow for the collection of two "replicate" filters (i.e., each filter represents the same sample collection duration, but different total sample air volumes). Only one of the two resulting air filters will be selected for analysis (see Section B4). Initially, the low flow pumps will be set to a flow rate of 2 liters per minute (L/min) and the high flow pumps will be set to a flow rate of 4

L/min. These flow rates may be revised as experience is gained on the degree of particulate loading on the filters during the activity. *Note: Flow rates should only be adjusted if the amount of particulate loading on the filter is impacting the flow rate. No adjustment is necessary if flow rates are able to be maintained, even if the filters appear to be visually overloaded. Due to the nature of the ABS activities, it is anticipated that most filters will likely require indirect preparation (with ashing) prior to TEM analysis.*

Each air sampling pump will be calibrated at the start of each ABS sampling period using the primary calibrator (BIOS Drycal). For pre-sampling purposes, calibration will be considered complete when the measured flow is within ±5% of the target flow, as determined by the mean of three measurements. Each BIOS Drycal used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag. Section B6/B7.1 provides detailed information on calibrating the sampling pump.

At the beginning of the sampling program, flow rates may be checked more frequently as conditions permit to establish expected conditions. To limit the amount of particulate loading on the filter, air cassettes should be replaced every 2 hours throughout the duration of the ABS activity. Set sampling durations have not been established for this ABS effort, rather air samples will be collected for as long as the activity takes to complete.

B2.4 Global Positioning System Coordinate Collection

GPS coordinates will be recorded for each tree where tree bark is collected and for each stationary monitor. (Because duff will be collocated with the sampled trees, no GPS coordinates are needed for duff samples.) In addition, GPS coordinates should be obtained to provide the spatial extent of the ABS area evaluated in the commercial logging activity. GPS location coordinates will be collected in general accordance with OU3-specific SOP No. 11, *GPS Data Collection* (see **Appendix C**).

B2.5 Equipment Decontamination

B2.5.1Sampling Equipment

Decontamination of non-disposable sampling equipment will be conducted in basic accordance with the procedures specified in OU3-specific SOP No. 7, *Equipment Decontamination* (see **Appendix C**). Materials used in the decontamination process will be disposed of as investigation-derived waste (IDW) as described below.

B2.5.2Commercial Logging Equipment

Before use on OU3, all vehicles and commercial logging equipment will be thoroughly cleaned to reduce the level of effort and water needed for post-ABS decontamination. Field personnel will thoroughly decontaminate any vehicle or commercial logging equipment prior to leaving the mine. In accordance with Section 10.3 of the *Libby Asbestos Superfund Site Operable Unit 3 Soil Disposal Plan* (CDM Smith 2011), field personnel will utilize pressurized water to wash all heavy equipment to remove any visible soil or debris before leaving the OU3 boundary. A competent person will inspect decontaminated vehicles prior to leaving the decontamination pad.

Before being taken off use from the project or before use in a clean area, all heavy equipment must undergo a full interior and exterior decontamination by the designated personnel. Full decontamination includes removing protective plating (skid plates), pressurized washing of all surfaces, cleaning the interior of the engine compartment, cleaning of the undercarriage, cleaning of the track adjusters, removing floor mats, and an extensive cleaning and wipe-down of the cab. In addition, designated personnel will remove, replace, and dispose of any air filters (air-intake, cab, etc.) from equipment and vehicles that have been inside the OU3 boundary. All filters from equipment that has been in the OU3 boundary will be disposed of as asbestos-containing material (ACM).

An inspector will evaluate and document the decontamination before moving or using the equipment. The inspector will fill out a Decontamination Checklist (see **Appendix D**). A copy of this form will be posted to the OU3 eRoom along with the field sample documentation.

B2.6 Handling Investigation-derived Waste

Any disposable equipment or other IDW will be handled in basic accordance with the procedures specified in OU3-specific SOP No. 12, *IDW Management* (see **Appendix C**). In brief, IDW will be double bagged in clear heavy-weight trash bags with 'IDW' written, in large letters at least 3 inches high, in indelible ink on at least two sides of the outer bag. All IDW generated during this sampling program will enter the waste stream at the local class IV asbestos landfill.

B3. SAMPLE HANDLING AND CUSTODY

B3.1 Sample Documentation

B3.1.1 Field Sample Data Sheets and Logbooks

As noted previously in Section A9, field teams will record sample information on the most current version of the OU3-specific FSDS form for each collected tree bark, duff, and ABS air sample (see **Appendix E**) in accordance with the procedures specified in OU3-specific SOP No. 9, *Field Documentation* (see **Appendix C)**.

The field logbook is an accounting of activities at the Site and will duly note problems or deviations from the governing SAP/QAPP or SOPs. Separate field logbooks will be kept for each study and the cover of each field logbook will clearly indicate the name of the associated study. Field logbooks will be completed prior to leaving a sampling location. Field logbooks will be checked for completeness on a daily basis by the field team leader (FTL) or their designate for the first week of each study. When incorrect field logbook completion procedures are discovered during these checks, the errors will be discussed with the author of the entry and corrected. Erroneous information recorded in a field logbook will be corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

Scanned copies of all FSDS forms and field logbooks will be posted to the OU3 eRoom on a weekly basis.

B3.1.2 Photographic and Video Documentation

Photographs will be taken to document representative examples of ABS scenarios performed, sampling locations and site conditions during ABS activities, pre-sampling conditions, and at any other location the field sampling personnel determine necessary, using a digital camera. As appropriate, digital video may be captured to document representative examples of ABS scenarios. Electronic copies of all digital photographs and video will be posted weekly to the OU3 eRoom. The file name should include the corresponding sampling location and/or sample number and the photograph date (e.g., OU3Log_7-15-12).

B3.2 Sample Labeling and Identification

Samples will be labeled with sample ID numbers using self-adhesive labels (as supplied by CDM Smith). For air samples, one sample label will be placed on the sampling cassette, one sample label will be affixed to the inside of the plastic bag used to hold the sampling cassette during transport. In addition, the sample ID number will also be written on the outside of the plastic bag. For duff and bark samples, the labels will be affixed to the outside of both the inner and outer sample bags and the sample ID number will be written on the outside of each bag.

Sample ID numbers will identify the samples collected during this sampling effort using the following format:

CL-3####

where:

CL-3 = A sample ID number prefix to identify samples collected under this SAP/QAPP

= A sequential four-digit number

B3.3 Field Sample Custody

Field sample custody will follow the requirements specified in OU3-specific SOP No. 9 (see **Appendix C**). In brief, all teams will ensure that samples, while in their possession, are maintained in a secure manner to prevent tampering, damage, or loss. All samples and FSDSs will be relinquished by field staff to the field sample coordinator or a designated secure sample storage location at the end of each day.

B3.4 Chain of Custody

The chain of custody (COC) record is employed as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through final data reporting. A completed COC record is required to accompany each shipment of samples. Sample custody will be maintained until final disposition of the samples by the laboratory and acceptance of analytical results by the EPA.

Appendix F contains COC forms that should be used in this investigation. COC procedures are specified in OU3-specific SOP No. 9 (see **Appendix C**). In brief, the field sample coordinator will prepare a hard copy COC form using the 3-page carbon copy forms developed specifically for use in this investigation. One copy of the COC will be retained by the field sample coordinator and the other two copies of the COC will accompany the sample shipment.

If any errors are found on a COC after shipment, the hard copy of the COC retained by the field sample coordinator will be corrected and a corrected COC will be provided to the LC (Remedium) for distribution to the appropriate laboratory.

B3.5 Sample Packaging and Shipping

Samples will be packaged and shipped in basic accordance with the procedures specified in OU3-specific SOP No. 8, *Sample Handling and Shipping* (see **Appendix C**). In brief, samples will be hand-delivered to the laboratory, picked up by a delivery service courier, or shipped by a delivery service to the designated facility or laboratory, as applicable. For samples requiring shipment, prior to sealing the shipping container, the field sample coordinator will complete the bottom of the COC record and retain the bottom copy of the COC record for the project record. The LC (Remedium) will instruct the field sample coordinator as to the appropriate laboratory for each sample shipment.

B3.6 Holding Times

In general, there are no holding time requirements for asbestos. Because sample preparation of the medium will address any issues due to elapsed time between collection and analysis (e.g., ashing of tree bark and duff material will address any organic growth that occurs), there are no holding time requirements for ABS air, duff material, or tree bark samples collected as part of this sampling investigation.

B3.7 Archival and Final Disposition

All sample materials, including filters, and grids will be maintained in storage at the analytical laboratory unless otherwise directed by the EPA. When authorized by the EPA, the laboratory will be responsible for proper disposal of any remaining samples, sample containers, shipping containers, and packing materials in accordance with sound environmental practice, based on the sample analytical results. The laboratory will maintain proper records of waste disposal methods, and will have disposal company contracts on file for inspection.

B4. ANALYTICAL METHODS

This section discusses the analytical methods and requirements for samples collected in support of the commercial logging ABS program. This section includes detailed information on the analysis of ABS air, duff materials, and tree bark, as well as the data reporting requirements, sample holding times, and custody procedures.

An analytical requirements summary sheet (**OU3LOG-0812**), which details the specific preparation and analytical requirements associated with this sampling program, is provided in **Appendix G**. The analytical requirements summary sheet will be reviewed and approved by all participating laboratories in this sampling program prior to any sample handling. A copy of this analytical requirements summary sheet will be submitted with each COC.

B4.1 Analysis of LA in ABS Air

The DQOs for the commercial logging ABS effort (see **Appendix A**) provide detailed information on the sample preparation, analysis method, counting rules, and stopping rules. Each of these analysis requirements is summarized below.

B4.1.1 Sample Preparation

Two filters are collected for each ABS participant during each sampling event – a high volume filter and a low volume filter. The high volume filter will be analyzed in preference to the low volume filter. If the high volume filter is deemed to be overloaded (i.e., > 25% particulate loading on the filter), the low volume filter should be analyzed in preference to performing an indirect preparation on the high volume filter. If the low volume filter is also deemed to be overloaded, an indirect preparation (with ashing) may be performed of the high volume filter in accordance with the procedures in Libby-specific SOP EPA-LIBBY-08. The filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of International Organization for Standardization (ISO) 10312:1995(E).

B4.1.2 Analysis Method

Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

B4.1.3 Counting Rules

Because of the high number of grid openings that are needed to achieve the target analytical sensitivity (see **Appendix A**), all ABS air samples will be examined using counting protocols for recording PCME structures only (per ISO 10312 Annex E). That is, filters will be examined at a magnification of about 5,000x, and all amphibole structures (including not only LA but all other amphibole asbestos types as well) that have appropriate selected area electron diffraction (SAED) patterns and energy-dispersive x-ray (EDXA) spectra, and having length > 5 micrometers (μm), width ≥ 0.25 μm, and aspect ratio ≥ 3:1 will be recorded on the OU3-specific TEM laboratory bench sheets and EDD spreadsheets. Data recording for chrysotile, if observed, is not required (but presence should be noted in the analysis comments).

B4.1.4 Stopping Rules

Appendix A provides detailed information on the derivation of the stopping rules for ABS air field samples analyzed by TEM. The stopping rules are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The target analytical sensitivity (0.0018 cc^{-1}) is achieved.
    b. 25 PCME LA structures have been observed.
    c. A total filter area of 20 mm^2 has been examined (this is approximately 2,000 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

For lot blanks and field blanks, the TEM analyst should examine an area of 1.0 mm^2 (approximately 100 grid openings).

B4.2 Analysis of LA in Duff Material

B4.2.1 Sample Preparation

Duff samples will be prepared and analyzed in basic accordance with the procedures specified in SOP EPA-LIBBY-2012-11, *Sampling and Analysis of Duff for Asbestos* (see **Appendix C**). In brief, each sample is dried and ashed, and an aliquot of the resulting ash residue is acidified, suspended in water, and filtered. The resulting filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E). Any remaining ash material will be archived for possible future analysis.

B4.2.2 Analysis Method and Counting Rules

Grids will be examined by TEM using high magnification (~20,000x) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by SOP EPA-LIBBY-2012-11. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 μm and an aspect ratio (length: width) ≥ 3:1, will be recorded.

B4.2.3 Stopping Rules

The stopping rules for the TEM analysis of duff materials are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
   a. The target analytical sensitivity (1E+07 grams, dry weight^{-1}) is achieved.
   b. 50 LA structures have been observed.
   c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

The results for each duff sample will be expressed in terms of LA structures per gram duff (dry weight).

B4.3 Analysis of LA in Tree Bark

B4.3.1 Sample Preparation

Tree bark samples will be prepared and analyzed in basic accordance with the procedures specified in EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix C**), with the following project modifications:

- Only one 0.25 gram aliquot of the resulting ash residue (rather than the total mass) will be filtered.

In brief, each sample is dried and ashed, and an aliquot of the resulting ash residue is acidified, suspended in water, and filtered. The resulting filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E). Any remaining ash material will be archived for possible future analysis.

B4.3.2 Analysis Method and Counting Rules

Grids will be examined by TEM using high magnification (~20,000x) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by SOP EPA-LIBBY-2012-12. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 µm and an aspect ratio (length: width) ≥ 3:1, will be recorded.

B4.3.3 Stopping Rules

The stopping rules for the TEM analysis of tree bark are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
   a. The target analytical sensitivity (100,000 cm^{-2}) is achieved.
   b. 50 LA structures have been observed.
   c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

The results for each tree bark sample will be expressed in terms of LA structures per cm^2 of tree bark (i.e., a surface area loading).

B4.4 Data Reporting

Analytical results will be recorded and results transmitted (including the detailed raw structure data from the TEM analysis) using the OU3-specific EDD spreadsheets for TEM results[7]. Standard project data reporting requirements will be met for this dataset. Upon completion of the appropriate analyses, EDDs will be posted to the Libby OU3 eRoom within the appropriate turn-around time. Hard copies of all analytical laboratory data packages will be scanned and

[7] The most current version of all EDDs are provided in the OU3 eRoom.

posted as a portable document format (.pdf) to the Libby OU3 eRoom. File names for scanned analytical laboratory data packages will include the laboratory name and the job number to facilitate document organization (e.g., LabX_12345-A.pdf).

B4.5 Analytical Turn-around Time

Analytical turn-around time will be negotiated between the LC and the laboratory. It is anticipated that a turn-around times of 2-3 weeks are acceptable, but this may be revised as determined necessary by the EPA.

B4.6 Custody Procedures

Specific laboratory custody procedures are provided in each laboratory's *Quality Assurance Management Plan*, which have been independently reviewed at the time of laboratory procurement. While specific laboratory sample custody procedures may differ between laboratories, the basic laboratory sample custody process is described briefly below.

Upon receipt at the facility, each sample shipment will be inspected to assess the condition of the shipment and the individual samples. This inspection will include verifying sample integrity. The accompanying COC record will be cross-referenced with all of the samples in the shipment. The laboratory sample coordinator will sign the COC record and maintain a copy for their project files.

Depending upon the laboratory-specific tracking procedures, the laboratory sample coordinator may assign a unique laboratory identification number to each sample on the COC. This number, if assigned, will identify the sample through all further handling at the laboratory. It is the responsibility of the laboratory manager to ensure that internal logbooks and records are maintained throughout sample preparation, analysis, and data reporting.

B5. QUALITY ASSURANCE/QUALITY CONTROL

B5.1 Field

Field QA/QC activities include all processes and procedures that have been designed to ensure that field samples are collected and documented properly, and that any issues/deficiencies associated with field data collection or sample processing are quickly identified and rectified. The following sections describe each of the components of the field QA/QC program implemented at the Site.

B5.1.1 Training

Before performing field work in Libby, field personnel are required to read all governing field guidance documents relevant to the work being performed and attend a field planning meeting specific to the commercial logging sampling effort. Additional information on field training requirements is provided in Section A8.1.

B5.1.2 Modification Documentation

Minor deviations (i.e., those that will not impact data quality or usability) encountered in day-to-day field work will be noted in the field logbook. Major deviations from this SAP/QAPP that modify the sampling approach and associated guidance documents will be recorded on a field ROM form (see **Appendix H**). Field ROMs will be completed by the FTL, or by assigned field or technical staff. Each completed ROM is assigned a unique number that is specific to each investigation (e.g., Logging LFM-OU3-01) by the EPA RPM or their delegate. Once a form is prepared, it is submitted to the EPA RPM for review and approval. Copies of approved field ROMs are available in the OU3 eRoom and are posted to the OU3 website.

B5.1.3 Field QC Samples

<u>Air</u>

Two types of field QC samples will be collected as part of the ABS air sampling portion of this program – lot blanks and field blanks.

Lot Blanks

Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. A lot blank is a randomly selected filter cassette from a manufactured lot. For this sampling effort, two lot blanks will be selected at random from the lot of cassettes to be used for the collection of ABS air samples. It is the responsibility of the FTL to submit the appropriate number of lot blanks to the laboratory prior to cassette use in the field. The lot blanks are analyzed for asbestos by TEM analysis as described above (see Section B4.1). Lot blank results will be reviewed by the FTL before any cassette in the lot is used for sample collection. The entire batch of cassettes will be rejected if any asbestos is detected on either lot blank. Only filter lots with acceptable lot blank results are placed into use for the ABS effort.

Field Blanks

Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. For this sampling effort, field blanks for ABS air will be collected at a rate of 1 per day. It is the responsibility of each field team to collect the appropriate number of field blanks. Field blanks are collected by removing the end cap of the sample cassette to expose the filter in the same area where sample collection occurs for about 30 seconds before re-capping the sample cassette. The field blanks are analyzed for asbestos by TEM analysis as described above (see Section B4.1).

If any asbestos is observed on a field blank, the FTL and/or laboratory manager will be notified and will take appropriate measures (e.g., re-training on sample collection and analysis procedures) to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "FB" will be added to the related field sample results in the project database to denote that the associated field blank had asbestos structures detected.

<u>Duff Material</u>

Only one type of field QC sample will be collected as part of the duff sampling portion of this program –field duplicates. Field blanks for duff are not required for this sampling program.

One field duplicate sample of duff material will be collected as part of this sampling program. The duff field duplicate should be collected at the same approximate location as the 5 duff sampling points as the parent sample (i.e., within 12 inches of the parent sampling points). It is the responsibility of the FTL to ensure that the field duplicate is collected. The field duplicate is given a unique sample number, and field personnel will record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same station location is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% confidence interval (CI) (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability.

<u>Tree Bark</u>

Two types of field QC samples may be collected as part of the tree bark sampling portion of this program – equipment rinsates (if necessary) and field duplicates. Field blanks for tree bark are not required for this sampling program.

Equipment Rinsates

Equipment rinsates are collected to evaluate potential contamination that arises to due inadequate decontamination of sampling equipment. *Equipment rinsates will only be collected if dedicated field sampling equipment (i.e., hole saws, chisels) is not utilized.* Following decontamination efforts, the decontaminated equipment (i.e., hole saw, chisel) should be rinsed with clean water (e.g., store-bought drinking water), and the resulting rinsate should be collected in an HDPE container. At least one equipment rinsate blank should be collected per equipment decontamination effort. It is the responsibility of each field team to collect the appropriate number of equipment rinsate blanks. Equipment rinsate blanks should be labeled with a unique sample number and submitted for analysis by TEM.

If any asbestos structures are observed on an equipment rinsate, the FTL and/or laboratory manager will be notified and will take appropriate measures to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "EB" will be added to the related field sample results in the project database to denote that the associated equipment rinsates had asbestos structures detected.

Field Duplicates

One field duplicate sample of tree bark will be collected as part of this sampling program. Field duplicates for tree bark are collected from the same tree as and in close proximity to (within 6 inches) the parent field sample. The field duplicate is collected using the same collection technique as the parent sample. It is the responsibility of the FTL to ensure that the field duplicate is collected. The field duplicate is given unique sample number, and field personnel will record the sample number of the associated co located sample in the parent sample number field of the FSDS. The same station location is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the analytical laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% CI (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability.

B5.2 Laboratory

Laboratory QA/QC activities include all processes and procedures that have been designed to ensure that data generated by an analytical laboratory are of high quality and that any problems in sample preparation or analysis that may occur are quickly identified and rectified. The following sections describe each of the components of the analytical laboratory QA/QC program implemented at the Site.

B5.2.1 Training/Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Additional information on laboratory training and certification requirements is provided in Section A8.2.

Laboratories handling samples collected as part of this sampling program will be provided a copy of and will adhere to the requirements of this SAP/QAPP. Samples collected under this SAP/QAPP will be analyzed in accordance with standard EPA and/or nationally-recognized analytical procedures (i.e., Good Laboratory Practices) in order to provide analytical data of known quality and consistency.

B5.2.2 Modification Documentation

When changes or revisions are needed to improve or document specifics about analytical methods or procedures used by the laboratory, these changes are documented using a laboratory ROM form (see **Appendix H**). The laboratory ROM form provides a standardized format for tracking procedural changes in sample analysis and allows project managers to assess potential impacts on the quality of the data being collected. Laboratory ROMs will be completed by the appropriate laboratory or technical staff. Once a form is prepared, it is submitted to the EPA RPM for review and approval. Copies of approved laboratory ROMs are available in the OU3 eRoom.

B5.2.3 Laboratory QC Analyses

<u>General Requirements</u>

The Libby-specific QC requirements for TEM analyses of asbestos are patterned after the requirements set forth by NVLAP. In brief, there are three types of laboratory-based QC analyses that are performed for TEM – laboratory blanks, recounts, and repreparations. Detailed information on the Libby-specific requirements for each type of TEM QC analysis, including the minimum frequency rates, selection procedures, acceptance criteria, and corrective actions are provided in the most recent version of Libby Laboratory Modification LB-000029, with the following investigation-specific modifications:

- Laboratory QC sample frequency requirements should be applied on an OU3-specific and medium-specific basis, rather than “across all media” as specified in LB-000029.

- For duff and tree bark samples, inter-laboratory analyses should be performed at a minimum frequency of 2% and repreparations at a minimum frequency of 4%. For ABS air samples, inter-laboratory analyses should be performed at a minimum frequency of 10% and repreparations at a minimum frequency of 10%.

With the exception of inter-laboratory analyses, it is the responsibility of the laboratory manager to ensure that the proper numbers of TEM QC analyses are completed. Inter-laboratory analyses for TEM will selected *post hoc* by the QATS contractor or their designate in accordance with the selection procedures presented in LB-000029. The LC will provide the list of selected inter-laboratory analyses to the laboratory manager and will facilitate the exchange of samples between the analytical laboratories.

<u>Duff and Tree Bark-specific Requirements</u>

In addition to the laboratory-based QC analyses discussed above, TEM analyses of tree bark and duff have additional QC analyses that are required, including drying blanks, filtration blanks, and laboratory duplicates. Detailed information on the Libby-specific requirements for each type of TEM QC analysis is provided in the medium-specific SOPs (i.e., EPA-LIBBY-2012-11 and EPA-LIBBY-2012-12). It is the responsibility of the laboratory manager to ensure that the proper number of TEM QC analyses is completed.

B6/B7. EQUIPMENT MAINTENANCE AND INSTRUMENT CALIBRATION

B6/B7.1 Field Equipment

B6/B7.1.1 Field Equipment Maintenance

All field equipment should be maintained and calibrated in basic accordance with manufacturer specifications. When a piece of equipment is found to be operating incorrectly, the piece of equipment will be labeled "out of order" and placed in a separate area from the rest of the sampling equipment. The person who identified the equipment as "out of order" will notify the FTL overseeing the investigation activities. It is the responsibility of the FTL to facilitate repair of the out-of-order equipment. This may include having appropriately trained field team members complete the repair or shipping the malfunctioning equipment to the manufacturer. Field team members will have access to basic tools required to make field acceptable repairs. This will ensure timely repair of any "out of order" equipment.

B6/B7.1.2 Air Sampling Pump Calibration

Each air sampling pump will be calibrated at the start of the sampling period each day using the primary calibrator (BIOS Drycal). For pre-sampling purposes, calibration will be considered complete when the measured flow is within ±5% of the target flow, as determined by the mean of three measurements. Each BIOS Drycal used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag.

B6/B7.2 Laboratory Instruments

The laboratory manager is responsible for ensuring that all laboratory instruments used for this project are maintained and calibrated in accordance with the manufacturer's instructions. If any deficiencies in instrument function are identified, all analyses shall be halted until the deficiency is corrected. The laboratory shall maintain a log that documents all routine maintenance and calibration activities, as well as any significant repair events, including documentation that the deficiency has been corrected.

B8. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

B8.1 Field Supplies

In advance of field activities, the FTL will check the field equipment/supply inventory and procure any additional equipment and supplies that are needed. The FTL will also ensure any in-house measurement and test equipment used to collect data/samples as part of this SAP/QAPP is in good, working order, and any procured equipment is acceptance tested prior to use. Any items that the FTL determines unacceptable will be removed from inventory and repaired or replaced as necessary.

Prior to use at OU3, all vehicles and commercial logging equipment should be inspected for leaks and any worn, damaged, or suspect fuel, coolant, or hydraulic fluid lines should be replaced. Prior to entering OU3, all vehicles and commercial logging equipment will be thoroughly cleaned to reduce the level of effort and water needed for post-ABS decontamination.

B8.2 Laboratory Supplies

The laboratory manager is responsible for ensuring that all reagents and disposable equipment used in this project is free of asbestos contamination. This is demonstrated by the collection of laboratory blank samples (see Section B5).

B9. NON-DIRECT MEASUREMENTS

There are no non-direct measurements that are anticipated for use in this project.

B10. DATA MANAGEMENT

All data generated as part of the commercial logging sampling investigation will be maintained in an OU3-specific Microsoft Access® database in accordance with the OU3-specific data management procedures specified below. The following sections provide a brief overview of the roles and responsibilities for data management and a summary of the data storage requirements for the OU3 project.

B10.1 Roles and Responsibilities

B10.1.1 Field Personnel

Remedium Group, Inc. contractors will perform all sample collection in accordance with this SAP/QAPP. In the field, sample details will be documented on hard copy media-specific FSDS forms and in field log books. COC information will be documented on hard copy forms. FSDS and COC information will be manually entered by the field sample coordinator (i.e., Remedium's field contractor) into a field-specific[8] OU3 database using electronic data entry forms. Use of electronic data entry forms ensures the accuracy of data entry and helps maintain data integrity. For example, data entry forms utilize drop-down menus and check boxes whenever possible. These features allow the data entry personnel to select from a set of standard inputs, thereby preventing duplication and transcription errors and limiting the number of available selections (e.g., media types). In addition, entry into a database allows for the incorporation of data entry checks. For example, the database will allow a unique sample ID number to only be entered once, thus ensuring that duplicate records cannot be created.

Entry of FSDS forms and COC information will be completed weekly, or more frequently as conditions permit. Copies of all FSDS forms, COC forms, and field log books will be scanned and posted as a pdf to the OU3 eRoom on a weekly basis. This eRoom will have controlled access (i.e., user name and password are required) to ensure data access is limited to appropriate project-related personnel. File names for scanned FSDS forms, COC forms, and field log books will include the sample date in the format YYYYMMDD to facilitate document organization (e.g., FSDS_20110412.pdf). Electronic copies of all digital photographs and videos will also be posted weekly to the OU3 eRoom.

After FSDS data entry is completed, a copy of the field-specific OU3 database will be posted by the field data manager to the OU3 eRoom on a week basis, or more frequently as conditions permit. The field-specific OU3 database posted to the eRoom site will include the post date in the file name (e.g., FieldOU3DB_20110516.mdb).

B10.1.2 Laboratory Personnel

Each of the laboratories performing asbestos analyses for this investigation are required to utilize all applicable OU3-specific Microsoft Excel® spreadsheets for asbestos data recording

[8] The field-specific OU3 database is a simplified version of the master OU3 database. This simplified database includes only the station and sample recording and tracking tables, as well as the FSDS and COC data entry forms.

and electronic submittals. Upon completion of the appropriate analyses, EDDs along with scanned copies of all analytical laboratory data packages will be posted to the OU3 eRoom.

B10.1.3 Database Administrators

Day-to-day operations of the master OU3 database will be under the control of EPA contractors. The primary database administrator (CDM Smith) will be responsible for sample tracking, uploading new data, performing error checks, and making any necessary data corrections. New records will be added to the master OU3 database within an appropriate time period of data receipt.

B10.2 Master OU3 Project Database

The master OU3 project database is a relational Microsoft Access® database developed specifically for OU3. The *Libby OU3 Database User's Guide* provides an overview of the master OU3 project database structure and content. The most recent version of this *User's Guide* is provided on the OU3 website.

The master OU3 project database is kept on the CDM Smith server in Denver, Colorado. Incremental backups of the master OU3 project database are performed daily Monday through Friday, and a full backup is performed each Saturday.

B10.3 Data Reporting

Field summary reports are prepared by Remedium's field collection contractor. Analytical results summaries are included in the OU3 investigation-specific SAPs and will be provided in the *OU3 Data Summary Report* (in preparation), which are available on the OU3 website. Specialized requests for data summaries may be submitted to the EPA RPM.

B10.4 Data Storage

All original data records (both hard copy and electronic) will be cataloged and stored in their original form until otherwise directed by the EPA RPM. At the termination of this project, all original data records will be provided to the EPA RPM for incorporation into the Site project files.

C Assessment and Oversight

C1. ASSESSMENT AND RESPONSE ACTIONS

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities.

C1.1 Assessments

C1.1.1 Field Oversight

Field surveillances consist of periodic observations performed by the field QAM made to evaluate adherence to investigation-specific governing documents. The schedule for performing field surveillances depends on the duration of the investigation, frequency of execution, and magnitude of process changes. At a minimum, a field surveillance will be performed during the first week of each study. Thereafter, surveillances will be conducted as necessary when field processes are revised or other QA/QC procedures indicates the possibility of deficiencies. When deficiencies are observed during the surveillances, the field QAM will immediately discuss the observation with the field team member and coordinate corrective measures with the FTL, if required. If the observer finds deficiencies across multiple field team members or teams, the FTL will plan and hold a field meeting. At this meeting, the observations made will be discussed and any corrective actions required (e.g., retraining) will be reviewed.

C1.1.2 Laboratory Oversight

Each laboratory working on the Libby project is required to participate in an annual on-site laboratory audit carried out by the EPA through the QATS contract. These audits are performed by EPA personnel (and their contractors), that are external to and independent of, the Libby team members. These audits ensure that each analytical laboratory meets the basic capability and quality standards associated with analytical methods for asbestos used at the Libby site. They also provide information on the availability of sufficient laboratory capacity to meet potential testing needs associated with the Site.

<u>External Audits</u>

Audits consist of several days of technical and evidentiary review of each laboratory. The technical portion of the audit involves an evaluation of laboratory practices and procedures associated with the preparation and analysis of samples for the identification of asbestos. The evidentiary portion of the audit involves an evaluation of data packages, record keeping, SOPs, and the laboratory's *QA Management Plan*. A checklist of method-specific requirements for the commonly used methods for asbestos analysis is prepared by the auditor prior to the audit, and used during the on-site laboratory evaluation.

Evaluation of the capability for a laboratory to analyze a sample by a specific method is made by observing analysts performing actual sample analyses and interviewing each analyst responsible for the analyses. Observations and responses to questions concerning items on each method-specific checklist are noted. The determination as to whether the laboratory has the capability to analyze a sample by a specific method depends on how well the analysts follow the protocols detailed in the formal method, how well the analysts follow the laboratory-specific method SOPs, and how the analysts respond to method-specific questions.

Evaluation of the laboratory to be sufficient in the evidentiary aspect of the audit is made by reviewing laboratory documentation and interviewing laboratory personnel responsible for maintaining laboratory documentation. This includes personnel responsible for sample check-in, data review, QA procedures, document control, and record archiving. Certain analysts responsible for method quality control, instrument calibration, and document control are also interviewed in this aspect of the audit. Determination as to the capability to be sufficient in this aspect is made based on staff responses to questions and a review of archived data packages and QC documents.

It is the responsibility of the QATS contractor to prepare an On-site Audit Report for each analytical laboratory participating in the Libby program. These reports are handled as business confidential items. The On-site Audit Report includes both a summary of the audit results and completed checklist(s), as well as recommendations for corrective actions, as appropriate. Responses from each laboratory to any deficiencies noted in the On-site Audit Report are also maintained with the respective reports.

It is the responsibility of the QATS contractor to prepare an On-Site Audit Trend Analysis Report on an annual basis. This report shall include a compilation and trend analysis of the on-site audit findings and recommendations. The purpose of this reported is to identify common asbestos laboratory performance problems and isolate the potential causes.

Internal Audits

Each laboratory will also conduct periodic internal audits of their specific operations. Details on these internal audits are provided in the laboratory *QA Management Plan*. The laboratory QAM should immediately contact the LC and the QATS contractor if any issues are identified during internal audits that may impact data quality for OU3 samples.

C1.2 Response Actions

Corrective response actions will be implemented on a case-by-case basis to address quality problems. Minor actions taken to immediately correct a quality problem will be documented in the applicable field or laboratory logbooks and a verbal report will be provided to the appropriate manager (e.g., the FTL or LC). Major corrective actions will be approved by the EPA RPM and the appropriate manager prior to implementation of the change. Major response actions are those that may affect the quality or objective of the investigation. The EPA RPM for OU3 will be notified when quality problems arise that that cannot be corrected quickly through routine procedures (contact information is provided below):

Christina Progess
U.S. EPA Region 8
1595 Wynkoop Street
Denver, CO 80202
Tel: (303) 312-6009
Fax: (303) 312-7151
E-mail: progess.christina@epa.gov

In addition, when modifications to this SAP/QAPP are required, either for field or laboratory activities, a ROM must be completed and approved by the EPA RPM prior to implementation.

C2. REPORTS TO MANAGEMENT

No regularly-scheduled written reports to management are planned as part of this project. However, QA reports will be provided to management for routine audits and whenever quality problems are encountered. Field staff will note any quality problems on FSDSs or in field logbooks. Further, the field and laboratory managers will inform the EPA RPM upon encountering quality issues that cannot be immediately corrected. Weekly reports are not required for work performed under this SAP/QAPP.

D Data Validation and Usability

D1. DATA REVIEW, VERIFICATION AND VALIDATION

D1.1 Data Review

Data review of project data typically occurs at the time of data querying by the data users and includes cross-checking that sample IDs and sample dates have been reported correctly and that calculated analytical sensitivities or reported values are as expected. If discrepancies are found, the data user will contact the EPA database administrator, who will then notify the appropriate entity (field, preparation facility, or laboratory) in order to correct the issue.

D1.2 Criteria for LA Measurement Acceptability

Several factors are considered in determining the acceptability of LA measurements in samples analyzed by TEM. This includes the following:

1. *Evenness of filter loading.* This is evaluated using a chi-square (CHISQ) test, as described in ISO 10312 Annex E. If a filter fails the CHISQ test for evenness, the result may not be representative of the true concentration in the sample, and the result should be given low confidence.

2. *Results of QC samples.* This includes both field and laboratory QC samples, such as field and laboratory blank samples, as well as various types of recount and re-preparation analyses. If significant LA contamination is detected in field or laboratory blanks, all samples prepared on that day should be considered to be potentially biased high. If agreement between original analyses and re-preparation or recount analyses is poor, results for those samples should be given low confidence.

D2. VERIFICATION AND VALIDATION METHODS

D2.1 Data Verification

Data verification includes checking that results have been transferred correctly from the original hand-written, hard copy field and analytical laboratory documentation to the OU3 project database. The goal of data verification is to identify and correct data reporting errors.

For analytical laboratories that utilize the OU3-specific EDD spreadsheets, data checking of reported analytical results begins with automatic QC checks that have been built into the spreadsheets. In addition to these automated checks, a detailed manual data verification effort will be performed for 100% of all ABS air and 10% of tree bark and duff samples. This data verification process utilizes Site-specific SOPs developed to ensure TEM results and field sample information in the OU3 database are accurate and reliable:

- EPA-LIBBY-09 – *SOP for TEM Data Review and Data Entry Verification* – This Site-specific SOP describes the steps for the verification of TEM analyses, based on a review of the laboratory benchsheets, and verification of the transfer of results from the benchsheets into the project database.

- EPA-LIBBY-11 - *SOP for FSDS Data Review and Data Entry Verification* – This Site-specific SOP describes the steps for the verification of field sample information, based on a review of the FSDS form, and verification of the transfer of results from the FSDS forms into the project database. An FSDS review is performed on all samples selected for TEM data verification.

The data verification review ensure that any data reporting issues are identified and rectified to limit any impact on overall data quality. If issues are identified during the data verification, the frequency of these checks may be increased as appropriate.

Data verification will be performed by appropriate CDM Smith staff that are familiar with project-specific data reporting, analytical methods, and investigation requirements. The data verifier will prepare a data verification report (template reports are included in the SOPs) to summarize any issues identified and necessary corrections. A copy of this report will be provided to the appropriate project data manager, LC, and the EPA RPM. It is the responsibility of the OU3 database manager (CDM Smith) to coordinate with the FTL and/or LC to resolve any OU3 project database corrections and address any recommended field or laboratory procedural changes from the data verifier. The OU3 database manager is also responsible for electronically tracking in the project database which data have been verified, who performed the verification, and when.

D2.2 Data Validation

Unlike data verification, where the goal is to identify and correct data reporting errors, the goal of data validation is to evaluate overall data quality and to assign data qualifiers, as appropriate, to alert data users to any potential data quality issues. Data validation will be performed by the QATS contractor (or their designate), with support from technical support staff that are familiar with project-specific data reporting, analytical methods, and investigation requirements.

Data validation for asbestos should be performed in basic accordance with the draft *National Functional Guidelines for Asbestos Data Review* (EPA 2011), and should include an assessment of the following:

- Internal and external field audit/surveillance reports
- Field ROMs
- Field QC sample results
- Internal and external laboratory audit reports
- Laboratory contamination monitoring results
- Laboratory ROMs
- Internal laboratory QC analysis results
- Inter-laboratory analysis results
- Performance evaluation results
- Instrument checks and calibration results
- Data verification results (i.e., in the event that the verification effort identifies a larger data quality issue)

A comprehensive data validation effort for OU3 should be completed quarterly and results should be reported as a technical memorandum. This technical memorandum shall detail the validation procedures performed and provide a narrative on the quality assessment for each type of asbestos analysis, including the data qualifiers assigned, and the reason(s) for these qualifiers. The technical memorandum shall detail any deficiencies and required corrective actions.

For OU3 reviews, electronic files summarizing the records that have been validated, the date they were validated, any recommended data qualifiers and their associated reason codes should be posted to the OU3 eRoom. It is the responsibility of the OU3 database manager (CDM Smith) to ensure that the appropriate data qualifiers and reason codes recommended by the data validator are added to the project database, and to electronically track in the project database which data have been validated, who performed the validation, and when.

In addition to performing quarterly data validation efforts, it is the responsibility of the QATS contractor (or their designate) to perform regular evaluations of all blanks, to ensure that any potential contamination issues are quickly identified and resolved. If any blank results are outside the acceptable limits, the QATS contractor should immediately contact the EPA RPM to ensure that appropriate corrective actions are made.

D3. RECONCILIATION WITH USER REQUIREMENTS

Once all samples have been collected and analytical data has been generated, data will be evaluated to determine if study objectives were achieved. It is the responsibility of data users to perform a data usability assessment to ensure that DQOs have been met, and reported investigation results are adequate and appropriate for their intended use. This data usability assessment should utilize results of the data verification and data validation efforts to provide information on overall data quality specific to each investigation.

The data usability assessment should evaluate results with regard to several data usability indicators, including precision, accuracy/ bias, representativeness, comparability, completeness, and whether specified analytic requirements (e.g., sensitivity) were achieved. **Table D-1** provides detailed information for how each of these indicators may be evaluated for the reported asbestos data. The data usability assessment results and conclusions should be included in any investigation-specific data summary reports.

Non-attainment of project requirements may result in additional sample collection or field observations in order to achieve project needs.

REFERENCES

Amandus HE, Wheeler R. 1987. The Morbidity and Mortality of Vermiculite Miners and Millers Exposed to Tremolite-Actinolite: Part II. Mortality. *Am. J. Ind. Med*. 11:15-26.

Bishop K, Ring S, Suchanek R, Gray D. 1978. Preparation Losses and Size Alterations for Fibrous Mineral Samples. *Scanning Electron Microsc.* I:207.

Breysse PN. 1991. Electron Microscopic Analysis of Airborne Asbestos Fibers. *Crit. Rev. Analyt. Chem.* 22:201-227.

CDM Smith. 2011. Libby Asbestos Superfund Site Operable Unit 3 Soil Disposal Plan, Libby Asbestos Project, Libby, Montana.

EPA. 1991. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Washington, DC. OSWER Directive 9355.0-30.

_____. 1992. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication 9285.7-081.

_____. 2001. EPA Requirements for Quality Assurance Project Plans, QA/R-5. Final. March.

_____. 2006. Guidance on Systematic Planning Using the Data Quality Objective Process, QA/G-4. February.

_____ 2007. Summary Report for Data Collected under the Supplemental Remedial Investigation Quality Assurance Project Plan Libby, Montana Superfund Site. U.S. Environmental Protection Agency, Region 8. October.

_____. 2008a. Performance Evaluation of Laboratory Methods for the Analysis of Asbestos in Soil at the Libby, Montana Superfund Site. Produced by Syracuse Research Corporation for EPA, Region 8. Draft – October 7, 2008.

_____. 2008b. Characteristic EDS Spectra for Libby-Type Amphiboles. Produced by Syracuse Research Corporation for EPA, Region 8. Final – March 18, 2008.

_____. 2008c. Framework for Investigating Asbestos-Contaminated Sites. Report prepared by the Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. OSWER Directive #9200.0-68.

____. 2010a. Activity-Based Sampling Summary Report, Operable Unit 4, Libby, Montana, Superfund Site. U.S. Environmental Protection Agency, Region 8. June 2.

____. 2010b. ProUCL Version 4.00.05 Technical Guide (Draft). U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/esd/tsc/ProUCL_v4.00.05/ProUCL_v4.00.05_tech_guide(draft).pdf

____. 2011. *National Functional Guidelines for Asbestos Data Review.* U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. Draft – August 2011.

HEI-AR. 1991. Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge. Health Effects Institute – Asbestos Research. Cambridge, Massachusetts.

International Organization for Standardization (ISO). 1995. Ambient Air – Determination of asbestos fibers – Direct-transfer transmission electron microscopy method. ISO 10312:1995(E).

Meeker GP, Bern AM, Brownfield IK, Lowers HA, Sutley SJ, Hoeffen TM, Vance JS. 2003. The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana. *American Mineralogist* 88:1955-1969.

McDonald JC, Harris J, Armstrong B. 2004. Mortality in a cohort of vermiculite miners exposed to fibrous Amphibole in Libby, Montana. *Occup. Environ. Med.* 61:363-366.

McDonald JC, McDonald AD, Armstrong B, Sebastien P. 1986. Cohort study of mortality of vermiculite miners exposed to tremolite. *Brit. J. Ind. Med.* 43:436-444.

Nelson W. 1982. *Applied Life Data Analysis.* John Wiley & Sons, New York. pp 438-446.

OSHA. 2002. OSHA 3096: Asbestos Standard for the Construction Industry (Revised). U.S. Department of Labor, Occupational Safety and Health Administration. http://www.osha.gov/Publications/OSHA3096/3096.html

Peipins LA, Lewin M, Campolucci S, Lybarger JA, Miller A, Middleton D, et al. 2003. Radiographic abnormalities and exposure to asbestos-contaminated vermiculite in the community of Libby, Montana, USA. *Environ. Health Perspect.* 111:1753-1759.

Rohs AM, Lockey JE, Dunning KK, Shulka R, Fan H, Hilbert T, Borton E, Wiot J, Meyer C, Shipley RT, LeMasters GK, Kapol V. 2007. Low level Fiber Induced Radiographic Changes Caused by Libby Vermiculite: A 25 year Follow-up Study. *Am J Respiratory and Critical Care Medicine.* Published online December 6, 2007 as doi:10.1164/rccm.200706-814OC.

Sahle W, Laszlo I. 1996. Airborne Inorganic Fibre Monitoring by Transmission Electron Microscope (TEM): Comparison of Direct and Indirect Sample Transfer Methods. *Ann. Occup. Hyg.* 40:29-44.

Sullivan PA. 2007. Vermiculite, Respiratory Disease and Asbestos Exposure in Libby, Montana: Update of a Cohort Mortality Study. *Environmental Health Perspectives* doi:10.1289/ehp.9481 Available online at http://dx.doi.org.

This page intentionally left blank to facilitate double-sided printing

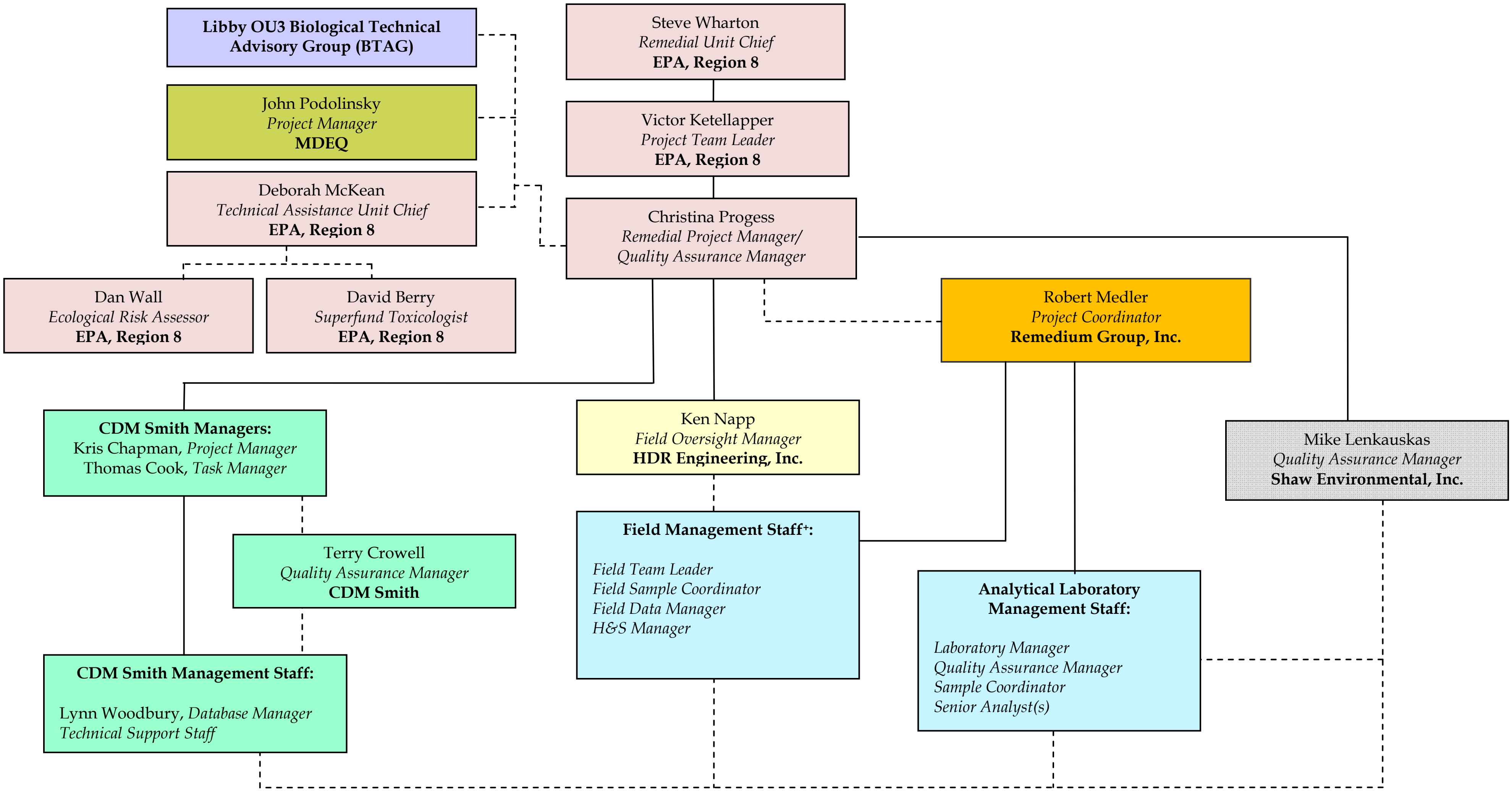


Figure A-1. General Organizational Chart for Libby OU3

EPA Region 8 Staff
CDM Smith Staff
HDR Staff
Lines of authority
Remedium Staff
Remedium Subcontractors
OU3 BTAG
Lines of communication
MDEQ Staff
Shaw Staff

+ Investigation-specific (the subcontractor selected to perform field work will depend upon the type of sample collection)

This page intentionally left blank to facilitate double-sided printing

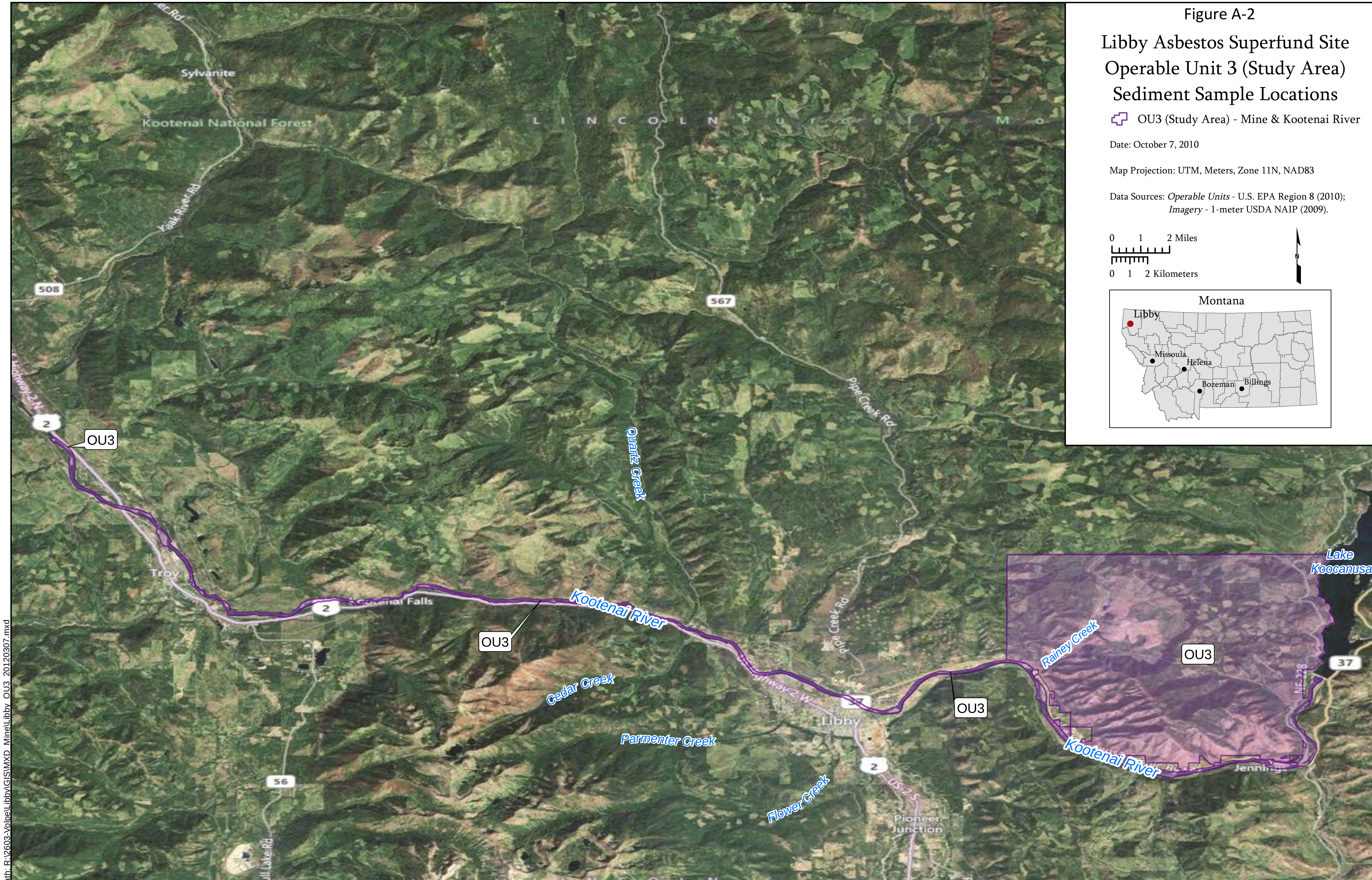
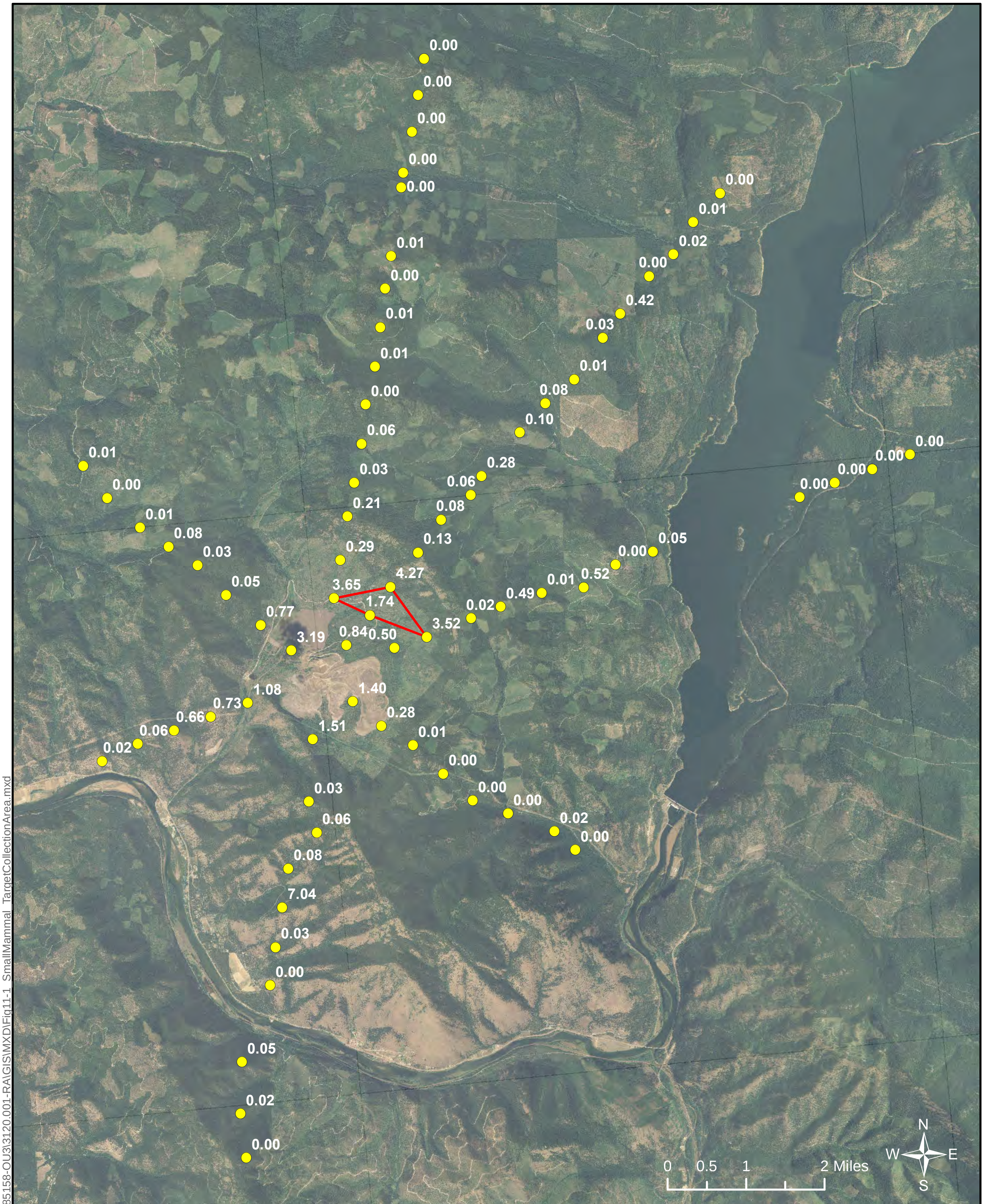


Figure A-2
Libby Asbestos Superfund Site
Operable Unit 3 (Study Area)
Sediment Sample Locations
OU3 (Study Area) - Mine & Kootenai River
Date: October 7, 2010
Map Projection: UTM, Meters, Zone 11N, NAD83
Data Sources: Operable Units - U.S. EPA Region 8 (2010); Imagery - 1-meter USDA NAIP (2009).
0 1 2 Miles
0 1 2 Kilometers
N
Montana
Libby
Missoula
Helena
Bozeman
Billings
Sylvanite
Kootenai National Forest
Yaak River Rd
508
567
Pipe Creek Rd
2
OU3
Quartz Creek
Troy
Kootenai Falls
Kootenai River
Lake Koocanusa
Rainey Creek
37
Cedar Creek
Parmenter Creek
Libby
Flower Creek
56
Bull Lake Rd
Pioneer Junction
Jennings
L I N C O L N
Path: R:\2603-Volpe\Libby\GIS\MXD_Mine\Libby_OU3_20120307.mxd

This page intentionally left blank to facilitate double-sided printing



CDM Smith

Measured duff LA concentration (as mass percent)

Target ABS Area

Figure B-1
OU3 Target ABS Area

Path: \\denqissvr1\LibbyGIS\85158-OU3\3120.001-RA\GIS\MXD\Fig11-1_SmallMammal_TargetCollectionArea.mxd

This page intentionally left blank to facilitate double-sided printing

Table D-1 General Evaluation Methods for Assessing Asbestos Data Usability

Data Usability Indicator	General Evaluation Method
Precision	Sampling – Review results for field duplicates to provide information on variability arising from medium spatial heterogeneity and sampling and analysis methods. Analysis – Review results for TEM recounts and repreparations to provide information on variability arising from analysis methods. Review results for inter-laboratory analyses to provide information on variability and potential bias between laboratories.
Accuracy/Bias	Calculate the background filter loading rate and use results to assign detect/non-detect in basic accordance with ASTM 6620-00.
Representativeness	Review relevant field audit report findings and any field/laboratory ROMs for potential data quality issues.
Comparability	Compare the sample collection SOPs, preparation techniques, and analysis methods to previous investigations.
Completeness	Determine the percent of samples that were able to be successfully collected and analyzed (e.g., 99 of 100 samples, 99%).
Sensitivity	Determine the fraction of all analyses that stopped based on the area examined stopping rule (i.e., did not achieve the target sensitivity).

ASTM = American Society of Testing and Materials
LA = Libby amphibole
ROM = record of modification
SOP = standard operating procedure
TEM = transmission electron microscopy

This page intentionally left blank to facilitate double-sided printing

APPENDIX A

DATA QUALITY OBJECTIVES FOR THE COMMERICAL LOGGING ABS

Data Quality Objectives (DQOs) are statements that define the type, quality, quantity, purpose, and use of data to be collected. The following sections implement the seven-step DQO process (EPA 2006) for the commercial logging ABS investigation.

Step 1: State the Problem

The Phase I remedial investigation for OU3 of the Libby Asbestos Site included collection of data on levels of LA in tree bark, duff, and forest soils within the Kootenai National Forest surrounding the mined area. The Phase I data indicate that LA was detected by polarized light microscopy (PLM) in soil at distances up to 2 miles from the mine in the downwind direction. LA was detected by transmission electron microscopy (TEM) in samples of tree bark and duff in downwind, cross wind, and upwind directions at distances from 3 to 7.5 miles from the mine. There is general tendency for the highest levels detected in tree bark, duff, and soil samples to occur within about 2 to 3 miles of the mined area.

As stated in the *Framework for Investigating Asbestos-Contaminated Superfund Sites* (EPA 2008), asbestos fibers in source materials are typically not inherently hazardous, unless the asbestos is released from the source material into air where it can be inhaled. If inhaled, asbestos fibers can increase the risk of developing lung cancer, mesothelioma, pleural fibrosis, and asbestosis. Thus, the evaluation of risks to humans from exposure to asbestos is most reliably achieved by the collection of data on the level of asbestos in breathing zone air during disturbance of asbestos source materials, referred to as activity-based sampling (ABS) (EPA 2008). While there have been several ABS studies conducted at OU3 to assess potential exposures to recreational visitors, residential wood harvesters, USFS workers, and firefighters in OU3, at present, there are no ABS data that are adequate to evaluate the exposures of commercial logging workers that harvest trees in OU3. Therefore, it is currently unknown whether LA concentrations in soil, tree bark, and duff in OU3 present an unacceptable risk to commercial logging workers.

Step 2: Identify the Goal of the Study

The goal of this study is to provide sufficient data to allow the EPA to complete an exposure assessment for commercial logging workers that harvest trees in OU3. The EPA will use the exposure assessment in an evaluation of risks to human health. The risk assessment will support decisions about whether or not response actions are needed to protect humans from unacceptable risks from LA in air that is attributable to releases from disturbances of contaminated environmental media in OU3.

Step 3: Identify Information Inputs

The information needed to characterize exposure of commercial logging workers to LA consist of reliable and representative measurements of LA in air during the harvesting of trees in OU3. Such measurements are obtained by drawing a known volume of air through a filter during various activities that disturb LA source materials and measuring the number of LA fibers that become deposited on the filter surface.

The following sections discuss the types of disturbance activities that should be evaluated, the types of ABS air samples that should be collected, and the analytical methods that should be used to analyze these ABS air samples.

Disturbance Activities

During a commercial logging operation, workers may disturb LA source materials by a variety of different activities. Based on a review of the logging narrative provided by the logging stakeholder group, and after observing logging operations at a state parcel near Libby Creek, it was determined that the ABS activities should include hand-felling of trees, skidding timber, mechanical limbing and cutting of timber, and mechanical preparation of area for re-planting. In addition, it is also desirable to obtain information on milling activities. If it is not possible to assess all these types of logging activities, focus should be placed on those activities that require specialized logging equipment and/or worker expertise.

Type of Air Sample

Experience at Libby and at other sites has demonstrated that personal air samples (i.e., samples that collect air in the breathing zone of a person) tend to have higher concentrations of LA than air samples collected by a stationary monitor (EPA 2007), especially if the person is engaged in an activity that disturbs an asbestos source material. Because personal air samples are more representative of breathing zone exposures, to the extent feasible, this study should focus on the collection of personal air samples that are located in the breathing zone of the individual performing the disturbance activity.

Analysis Method

ABS air samples should be analyzed for asbestos using transmission electron microscopy (TEM). For ABS air samples, because asbestos toxicity depends on the particle size and mineral type, results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). In addition, because it is possible that there could be various sources of LA present, information on the sodium and potassium content of each LA structure observed, as determined by energy dispersive spectroscopy (EDS), should also be recorded. This requirement is based on the observation of Meeker et al. (2003) that most particles from the Libby ore body contain detectable levels of both sodium and potassium, whereas other potential sources of LA may not.

Step 4: Define the Bounds of the Study

Spatial Bounds

Ideally, ABS sampling for the commercial logging scenario would occur at multiple areas within OU3, to allow risks to be calculated at various distances from the mine and in all directions. However, this would require ABS sampling over an area of more than 100 square miles. Available data on levels of LA measured in tree bark, soil and duff indicate that, in general, the levels of LA tend to decrease with distance away from the center of the mine. Therefore, the approach that will be taken at OU3 is to collect ABS samples in an area that is representative of high potential LA exposure (e.g., in an area of OU3 that is predominantly downwind from the mine where high concentrations of LA have been reported in tree bark and duff) and to assume that the risks calculated at this location are equal to or greater than the risks at equal distances from the mine in the crosswind and upwind directions and at distances that are further from the mine. This approach will help ensure that assumed risks at other OU3 locations are more likely to be overestimated than underestimated.

If deemed necessary to support risk management decisions, additional ABS efforts at locations where LA levels in source materials are lower may be warranted.

Temporal Bounds

The release of LA from source materials (soil, duff, tree bark) into air is expected to depend on several factors that may tend to vary over time, including, for example, the moisture content of the source, the amount of ground cover, and the wind speed and direction when disturbance occurs. In general, it is expected that human exposures are more likely to occur when snow is limited or absent from OU3, and that releases will tend to be higher in the dry summer months (July-September) than during wet conditions in spring or fall. Thus, by collecting ABS data in the summer months, this approach will help ensure that the mean concentration calculated using the set of measurements obtained during dry periods is more likely to overestimate than underestimate the actual long-term mean exposure.

If deemed necessary to support risk management decisions, additional ABS efforts at times when exposures may be reduced due to temporal factors (e.g., during the winter when sources are covered by snow) may be warranted.

Step 5: Define the Analytical Approach

The results of this ABS study will be used to calculate an exposure point concentration (EPC). The EPC will be calculated as the average measured ABS air concentration. The EPC will be combined with assumptions about exposure frequency and duration and toxicity factors for LA in a baseline human health risk assessment for OU3 that is expected to provide a basis for the EPA to determine, in consultation with MDEQ, whether response action is needed within OU3 to protect human health.

The EPA has recently proposed LA-specific toxicity values for use in estimating cancer risks and non-cancer hazard quotients (HQs) from exposures to LA in air. The lifetime inhalation unit risk (IUR) value is 0.17 LA phase contrast microscopy (PCM)[9] (structures per cubic centimeter [s/cc])$^{-1}$ and the lifetime reference concentration (RfC) value is 0.00002 LA PCM s/cc (EPA 2011). The EPA is currently reviewing these values. Basic methods for estimating human health risk from LA in air are provided below.

Estimation of Cancer Risk

The basic equation for estimating cancer risk from LA using the LA-specific IUR value is as follows:

$$\text{Risk} = \text{EPC} * \text{TWF}_c * \text{IUR}_{LA}$$

where:

Risk = Lifetime excess risk of developing cancer (lung cancer or mesothelioma) as a consequence of site-related LA exposure.

EPC = Exposure point concentration of LA in air (PCM or PCM-equivalent [PCME] s/cc). The EPC is an estimate of the long-term average concentration of LA in inhaled air for the specific activity being assessed.

TWF_c = Time-weighting factor for cancer. The value of the TWF term ranges from zero to one, and describes the average fraction of a lifetime during which exposure occurs from the specific activity being assessed. Because the IUR incorporates a lag of 10 years, the duration of a lifetime is assumed to be 60 rather than the usual 70 years:

[9] Calculations of human exposure and risk from asbestos in air are expressed in terms of PCM s/cc. When analysis is performed by TEM, structures that satisfy PCM counting rules are referred to as PCM-equivalent (PCME) structures. The PCM counting rules include structures with a length > 5 microns (µm), a width greater than or equal to (≥) 0.25 um, and an aspect ratio ≥ 3:1.

$TWF = ET/24 * EF/365 * ED/60$

where:

ET = Average exposure time (hrs/day)
EF = Average exposure frequency (days/year)
ED = Exposure duration (years)

IUR_{LA}= LA-specific lifetime inhalation unit risk (LA PCM s/cc)$^{-1}$

Estimation of Non-Cancer Hazard Quotient

The basic equation for characterizing non-cancer risk from LA using the LA-specific RfC value is as follows:

$$HQ = EPC * TWF_{nc} / RfC_{LA}$$

where:

HQ = Hazard quotient for non-cancer effects from site-related LA exposure

EPC = Exposure point concentration of LA in air (PCM or PCME s/cc)

TWF_{nc} = Time-weighting factor for non-cancer, which is calculated as:

$TWF = ET/24 * EF/365 * ED/70$

where:

ET = Average exposure time (hrs/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

RFC_{LA} = LA-specific lifetime reference concentration (LA PCM s/cc)

Decision Rule

The EPA guidance provided in OSWER Directive #9355.0-30, "*Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*" (EPA 1991) indicates that if the cumulative cancer risk to an individual based on reasonable maximum exposure (RME) is less than 1E-04 and the non-cancer HQ is less than 1, then remedial action is generally not warranted unless there are adverse environmental impacts. The guidance also states that a risk manager may decide that a risk level lower than 1E-04 is unacceptable and that remedial action is warranted where there are uncertainties in the risk assessment results.

Step 6: Specify Performance Criteria

In making decisions about the risks to humans in OU3, two types of decision errors are possible:

- A *false negative decision error* would occur if a risk manager decides that exposure to LA in OU3 is not of health concern, when in fact it is of concern.

- A *false positive decision error* would occur if a risk manager decides that exposure to LA in OU3 is above a level of concern, when in fact it is not.

The EPA is most concerned about guarding against the occurrence of false negative decision errors, since an error of this type may leave humans exposed to unacceptable levels of LA. To minimize chances of underestimating the true amount of exposure and risk, the EPA generally recommends that risk calculations be based on the 95 percent upper confidence limit (95UCL) of the sample mean (EPA 1992). Use of the 95UCL in risk calculations limits the probability of a false negative decision error to no more than 5 percent. To support this approach, the EPA has developed a software application (ProUCL) to assist with the calculation of 95UCL values (EPA 2010b). However, equations and functions in ProUCL are not designed for asbestos datasets and application of ProUCL to asbestos datasets is not recommended (EPA 2008). The EPA is presently working to develop a new software application that will be appropriate for use with asbestos datasets, but the application is not yet available for use. Because the 95UCL cannot presently be calculated with confidence, risk calculations will be based on the sample mean only, as recommended by EPA (2008). This means that risk estimates may be either higher or lower than true values, and this will be identified as a source of uncertainty in the risk assessment.

The EPA is also concerned with the probability of making false positive decision errors. Although this type of decision error does not result in unacceptable human exposure, it may result in unnecessary expenditure of resources. The risk of false positive decision errors can be minimized by increasing the number of samples. The number of samples needed depends on the magnitude of between-sample variability and the proximity of EPC to the decision threshold. If between-sample variability is low, or if the EPC is not near a decision threshold, then the number of samples needed is relatively low. However, if between-sample variability is high and the EPC is relatively near a decision threshold, then the number of samples needed is usually higher. Based on measured data from previous outdoor ABS sampling efforts (EPA 2010a), there is often substantial variability in measured ABS concentrations of LA in air and measured concentrations may be near risk management decision thresholds. Therefore, there is a need to collect multiple samples to limit the level of uncertainty. Because it is not possible at present to quantify the uncertainty in the mean of an asbestos dataset as a function of the number of samples, it is not possible to calculate a minimum number of samples required to minimize the risk of false positive decision errors.

Step 7: Develop the Plan for Obtaining Data

A detailed study design for the collection of commercial logging ABS data in OU3 is provided in Section B1 of this SAP/QAPP. Key features of this study design are discussed below.

Activities to be Included in the ABS

During a commercial logging operation, workers may disturb LA source materials by a variety of different activities. Unlike traditional ABS efforts, where the ABS scenario is conducted in accordance with a specific script that details the particular activities that should be conducted, how they should be conducted, where they should be conducted, and for how long, the commercial logging ABS script is designed to simply monitor worker exposures under authentic commercial logging conditions. It is anticipated that these activities will include hand-felling of trees, skidding operations, mechanical processing of harvested trees (limb removal and cutting), milling activities, and site preparation for replanting using heavy machinery.

Selection of Sampling Location

Because of the very complex nature of the source material (a mixture of duff, soil, and tree bark), the difficulty in thoroughly characterizing the LA concentrations in these source media, and the potential difficulty in establishing a reliable quantitative relation between source and ABS air, no attempt will be made to establish a quantitative relation between LA levels in source media and the mean concentration in ABS air. Rather, ABS air data will be collected at a location in OU3, selected to be representative of an area of high potential LA exposure where commercial logging could occur.

The strategy for selection of the sampling location is based mainly on a consideration available data on LA levels in source media (i.e., duff, tree bark, and soil). The ABS area should be in close proximity to the mine and in the downwind direction (north-northeast) from the mine site. In addition, the ABS area should be accessible to logging operations (i.e., roads are available that can enable equipment access to trees).

The EPA should be immediately notified in the event that any changes in the ABS area are needed for reasons of safety or implementation.

Timing of the ABS Effort

Commercial logging ABS efforts will be conducted in the summer of 2012, when environmental conditions are likely to be driest (i.e., August-September). To avoid collecting data that are biased low, ABS sampling will not occur during or within 1 day of rainfall (>1/4 inch).

If the results from the summer ABS effort show that resulting exposures are above a level of potential concern, an additional ABS event may be conducted in the winter to provide information that may be used in support of a possible institutional control for seasonal restrictions on commercial logging in OU3.

Optimizing Sample Number

As noted above, there is often substantial variability in measured ABS concentrations of LA in air due to outdoor source disturbances. Ideally, to limit uncertainty in the calculation of long-term exposures, the goal would be to collect multiple samples during the commercial logging scenario that encompass the range of conditions that influence sampling variability. However, due to the nature of this ABS effort – a small-scale commercial logging effort on a parcel of limited size with a limited number of participating workers – it may not be possible to collect enough samples to fully characterize the extent of variability within each scenario. To the extent feasible, this study should maximize the number of samples collected such that there are multiple air measurements across multiple workers and multiple days.

If the results of the commercial logging ABS effort show that the data are variable and/or are near a decision threshold, additional sampling may be needed to support risk management decision-making.

Optimizing the Sample Collection Strategy

Two key variables that may be adjusted during collection of air samples are sampling duration and pump flow rate. The product of these two variables determines the amount of air drawn through the filter, which in turn is an important factor in the analytical cost and feasibility of achieving the target analytical sensitivity (TAS). In general, longer sampling times are preferred over shorter sampling times because a) longer time intervals are more likely to yield representative measures of the average concentration (as opposed to short-term fluctuations), and b) longer collection times are associated with higher volumes, which makes it easier to achieve the TAS. Likewise, higher flow rates are generally preferred over lower flow rates because high flow results in high volumes drawn through the filter over shorter sampling times.

However, there is a limit to how much air can be drawn through a filter. In cases where the air being sampled contains a significant level of airborne particulates (e.g., dust, sawdust), it is possible that particulate loading on the filter could influence the ability to maintain the optimal flow rate. To minimize this possibility, pump flow rates should be checked regularly throughout the collection period and filter cassettes should be changed if flow rates become impacted.

While particulate loading on the filter may not impact pump flow rates, it is possible that the filter will become so overloaded with airborne particulates that the filter cannot be examined directly by the TEM analyst. In this event, the filter must undergo an "indirect" preparation in which the original filter is ashed and the resulting residue is suspended in water and re-deposited on a "secondary" filter, such that the secondary filter is not overloaded. In some cases, indirect preparation of air samples may alter (usually increase) the observed concentration of asbestos in air samples. The EPA Region 8 has reviewed published studies on this topic (see HEI-AR 1991 and Breysse 1991 for reviews), and interprets the data to indicate that, in contrast to what is usually observed in the case of chrysotile asbestos, effects of indirect preparation of samples containing amphibole asbestos are generally small (e.g., Bishop *et al.* 1978, Sahle and Laszlo 1996, Berry *et al.* 2012). However, to reduce the frequency of indirect preparations, ABS samples will be collected using two different sampling pumps – one that operates at a high flow rate and one that operates at a low flow rate. Whenever possible, the filter from the high flow pump will be selected for analysis. In cases where the high flow filter is deemed to be overloaded (i.e., the particulate loading on the filter is > 25%), then the low flow filter will be analyzed. If both filters are deemed to be overloaded, the high flow filter will be prepared indirectly following ashing.

<u>Analytical Requirements for ABS Air Samples</u>

In general, three alternative stopping rules are specified for TEM analyses to ensure resulting data are adequate:

1. The TAS to be achieved
2. A maximum number of structures to be counted
3. A maximum area of filter to be examined

The basis for each of these values for this study is presented below.

Target Analytical Sensitivity

The level of analytical sensitivity needed to ensure that analysis of ABS air samples will be adequate is derived by finding the concentration of LA in ABS air that might be of potential concern, and then ensuring that if an ABS sample were encountered that had a true concentration equal to that level of concern, it would be quantified with reasonable accuracy. This process is implemented below:

Step 1. Calculation of Risk-Based Concentrations

Cancer. The basic equation for calculating the risk-based concentration (RBC) for cancer is:

$$RBC(cancer) = Maximum\ Acceptable\ Cancer\ Risk / (TWF_c * IUR)$$

For cancer, the maximum acceptable risk is a risk management decision. For the purposes of calculating an adequate TAS, a value of 1E-05 is assumed.

The exposure parameters needed to calculate TWF are not known with certainty, so the following RME exposure parameters were selected based on information provided by local commercial logging workers on potential exposures for workers in the Libby Valley:

Exposure Parameter	Hand-felling	Skidding/mechanical processing/site preparation
Exposure Time	8 hours/day	10 hours/day
Exposure Frequency	140 days/year	160 days/year
Exposure Duration (Libby Valley)	6 years	12 years

Because individuals performing skidding/mechanical processing/site preparation operations tended to have higher exposures than individuals performing hand-felling operations, this exposure scenario was utilized to compute the TAS. For the purposes of deriving the TAS, it was assumed that only about 10% of the time spent logging within the Libby Valley would be within OU3.

Based on these exposure parameters, the TWF_c is 0.0031 (10/24 * 160/365 * 12/70 * 0.1 = 0.0031). Thus, the RBC for cancer is 0.019 LA PCME s/cc.

Non-Cancer. The basic equation for calculating the RBC for non-cancer effects is:

$$RBC(non\text{-}cancer) = (Maximum\ Acceptable\ HQ * RfC) / TWF_{nc}$$

For non-cancer, the maximum acceptable HQ is 1. Based on the exposure parameters presented above, the TWF_{nc} is 0.0037 (10/24 * 160/365 * 12/60 * 0.1 = 0.0037). Thus, the RBC for non-cancer is 0.0055 LA PCME s/cc.

Because the non-cancer RBC is lower than the cancer RBC, the non-cancer RBC is used to derive the TAS.

Step 2: Determining the Target Analytical Sensitivity

The TAS is determined by dividing the RBC by the target number of structures to be observed during the analysis of a sample with a true concentration equal to the RBC:

TAS = RBC / Target Count

The target count is determined by specifying a minimum detection frequency required during the analysis of samples at the RBC. This probability of detection is given by:

Probability of detection = 1 - Poisson(0,Target Count)

Assuming a minimum detection frequency of 95 percent, the target count is 3 structures. Based on this, the TAS is:

TAS = (0.0055 s/cc) / (3 s) = 0.0018 cc^{-1}

Maximum Number of LA Structures

Ideally, all samples would be examined by TEM until the TAS is achieved. However, for filters that have high asbestos loading, reliable estimates of concentration may be achieved before achieving the TAS. This is because the uncertainty around a TEM estimate of asbestos concentration in a sample is a function of the number of structures observed during the analysis. The 95% confidence interval (CI) around a count of N structures is computed as follows:

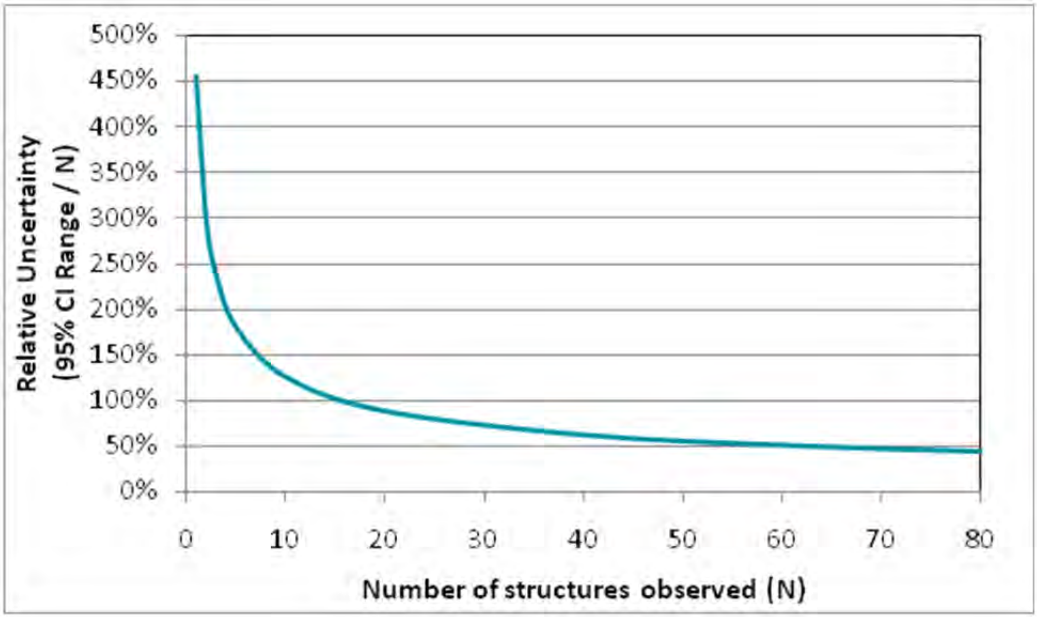
Lower bound (2.5%) = ½ · CHIINV(0.975, 2 · $N_{observed}$ + 1)
Upper bound (97.5%) = ½ · CHIINV(0.025, 2 · $N_{observed}$ + 1)

As N_{obs} increases, the absolute width of the CI range increases, but the relative uncertainty (expressed as the CI range divided by N_{obs}) decreases. This concept is illustrated in the figure below.

The goal is to specify a target N such that the resulting Poisson variability is not a substantial factor in the evaluation of method precision. As shown in the figure, above about 25 structures, there is little change in the relative uncertainty. Therefore, the count-based stopping rule for TEM should utilize a maximum structure count of 25 structures.

Because the ABS air concentrations will be used to estimate potential risks, which are derived based on the total number of structures that meet PCM counting rules, the maximum structure count is applicable to PCME LA structures (not total LA structures).

RELATIONSHIP BETWEEN THE NUMBER OF STRUCTURES OBSERVED AND RELATIVE UNCERTAINTY



CI = confidence interval

Maximum Area to be Examined

The number of grid openings that must be examined (GOx) to achieve the target analytical sensitivity is calculated as:

$$GOx = EFA / (TAS \cdot Ago \cdot V \cdot 1000 \cdot f)$$

where:

EFA = Effective filter area (assumed to be 385 mm^2)
TAS = Target analytical sensitivity $(cc)^{-1}$
Ago = Grid opening area (assumed to be 0.01 mm^2)
V = Sample air volume (L)
1000 = L/cc (conversion factor in L/cc)
f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

A total of about 440 grid openings will need to be examined to achieve the target analytical sensitivity, assuming an air sample volume of 960 liters (4 hour sample duration x 60 minutes/hour x 4 liters/minute flow rate) and that the filter is prepared indirectly at an f-factor of 0.05. The number of grid openings that will need to be examined is inversely proportional to the dilution needed (i.e., an f-factor of 0.01 will increase the number of grid openings by a factor of 5). If the f-factor is very small, it is possible that the number of grid openings that would need to be examined to achieve the target analytical sensitivity may be cost or time prohibitive. In order to limit the maximum effort expended on any one sample, a maximum area examined of 0.5 mm^2 is identified for this project. Assuming that each grid opening has an area of about 0.01 mm^2, this would correspond to about 500 grid openings.

Summary of TEM Stopping Rules

The TEM stopping rules for this study should be as follows:

1. Examine a minimum of two grid openings from each of two grids.
2. Continue examining grid openings until one of the following is achieved:
    a. The TAS (0.0018 cc^{-1}) is achieved.
    b. 25 PCME LA structures have been observed.
    c. A total filter area of 0.5 mm^2 has been examined.

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

REFERENCES

Berry, D, et al. 2012. Comparison of Amphibole Air Concentrations Resulting from Direct and Indirect Filter Preparation and Transmission Electron Microscopy Analysis. *Journal of Occupational & Environmental Hygiene [in preparation]*

Bishop K, Ring S, Suchanek R, Gray D. 1978. Preparation Losses and Size Alterations for Fibrous Mineral Samples. *Scanning Electron Microsc.* I:207.

Breysse PN. 1991. Electron Microscopic Analysis of Airborne Asbestos Fibers. *Crit. Rev. Analyt. Chem.* 22:201-227.

EPA. 1991. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Washington, DC. OSWER Directive 9355.0-30.

_____. 1992. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication 9285.7-081.

_____. 2006. Guidance on Systematic Planning Using the Data Quality Objective Process, QA/G-4. February.

_____ 2007. Summary Report for Data Collected under the Supplemental Remedial Investigation Quality Assurance Project Plan Libby, Montana Superfund Site. U.S. Environmental Protection Agency, Region 8. October.

_____. 2008. Framework for Investigating Asbestos-Contaminated Sites. Report prepared by the Asbestos Committee of the Technical Review Workgroup of the Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency. OSWER Directive #9200.0-68.

____. 2010a. Activity-Based Sampling Summary Report, Operable Unit 4, Libby, Montana, Superfund Site. U.S. Environmental Protection Agency, Region 8. June 2.

____. 2010b. ProUCL Version 4.00.05 Technical Guide (Draft). U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-07/041. May 2010. http://www.epa.gov/esd/tsc/ProUCL_v4.00.05/ProUCL_v4.00.05_tech_guide(draft).pdf

_____. 2011. Remedial Investigation for Operable Unit 3, Libby Asbestos Superfund Site. Phase IV Sampling And Analysis Plan Part A – Data to Support Human Health Risk Assessment. Addendum: Opportunistic Sampling During Authentic Wildfires. Prepared for, and with oversight by U.S. Environmental Protection Agency, Region 8, Denver, CO, by CDM, Denver, CO and SRC, Inc, Denver, CO. August 20, 2011

HEI-AR. 1991. Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge. Health Effects Institute – Asbestos Research. Cambridge, Massachusetts.

Meeker GP, Bern AM, Brownfield IK, Lowers HA, Sutley SJ, Hoeffen TM, Vance JS. 2003. The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana. *American Mineralogist* 88:1955-1969.

Sahle W, Laszlo I. 1996. Airborne Inorganic Fibre Monitoring by Transmission Electron Microscope (TEM): Comparison of Direct and Indirect Sample Transfer Methods. *Ann. Occup. Hyg.* 40:29-44.

APPENDIX B

COMMERICAL LOGGING ABS SCRIPT

All commercial ABS scenarios will be conducted in the specified ABS area (see Figure B-1 in the SAP/QAPP). Equipment and or vehicle with on- and off-road capability and 2,500-gallon water capacity will be stationed at the landing area to suppress any fires that may occur during the ABS activities.

Hand-Felling

Hand felling has been identified as being a commonly utilized method to fell timber within the Libby Valley. Each individual sawyer participating in hand-felling activities will wear two sampling pumps – a high volume pump and a low volume pump – attached such that the sample collection is in close proximity to the breathing zone (e.g., shoulder). Thus, two filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter) for each individual.

During the hand-felling activity, the sawyer(s) will utilize a chain saw to fell trees located within the ABS area. Trees to be felled should be Douglas fir with a diameter (caliper) of at least 8 inches. If these trees are not available, trees with a large diameter and rough bark will be selected preferentially. The sawyer will fell marked trees until a total of 100 trees have been felled. Air sampling cassettes will be changed out every 2 hours.

Skidding/Hooking of Timber

Both skidding and hooking operations are methods commonly practiced within the Libby Valley during commercial logging operations. For this ABS scenario, the skidder operator will wear two sampling pumps – a high volume pump and a low volume pump – attached such that the sample collection is in close proximity to the breathing zone (e.g., shoulder). Thus, two filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter) for the skidder operator.

Trees to be utilized during the skidding scenario will be the same trees that were felled during the hand-felling ABS scenario. During the skidding activity, one operator will utilize a machine to gain access to felled trees. The skidder operator will exit the machine cab and attach cables to felled trees. Once trees are hooked with cables, the operator will re-enter the machine cab and drag the hooked trees to the landing area for the mechanical processing scenario. The skidder operator will continue this process until all 100 felled trees have been skidded to the mechanical processing staging area. Air sampling cassettes will be changed out every 2 hours.

Mechanical Processing

For the mechanical processing ABS scenario, air sampling equipment will be placed within the cab of the machine in an area representative of the operator's breathing zone. Two sampling pumps will be utilized – a high volume pump and a low volume pump – thus, two filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter).

Trees to be utilized during the processing scenario will be the same trees felled during the hand-felling ABS scenario and moved to the landing area via operations during the skidding ABS scenario. During the processing activity, one operator will utilize a machine to gain access to the felled trees located at the landing area. The timber processing operator will process trees (i.e., de-limb and cut timber to length) in the landing area and move the processed trees to the loading deck. The operator will continue this process until all 100 trees have been processed. Air sampling cassettes will be changed out every 2 hours.

Milling Process

For the milling process ABS scenario, slabs will be cut from logs prepared following the mechanical processing scenario. The purpose of cutting logs into slabs is to remove the bark from the logs in order to minimize the amount of core wood put through the chipper. Once slabs with bark remaining have been milled to the extent possible, a laborer will continually feed slabs through a chipper to simulate a mill debarking scenario. Air sampling equipment will be placed at varying distances in a downwind direction from the discharge side of the chipper at a height representative of an average persons breathing zone (4-6 feet). Two sampling pumps for each two locations will be utilized, a high volume pump and a low volume pump – thus, four filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter). Both a high volume and low volume pump will be placed at a distance of approximately 10 feet from the discharge side of the chipper, in a downwind direction. In addition, both a high volume and low volume pump will be placed at a distance of approximately 50 feet from the discharge side of the chipper in a downwind direction, these distances may need to be adjusted, based on the force of the chip discharge. This activity will continue until all logs from the mechanical processing scenario have been chipped. Air sampling cassettes will be changed out every two hours.

Site Preparation for Replanting

This ABS event will not include a replanting component. For the site preparation ABS scenario, air sampling equipment will be placed within the cab of the machine in an area representative of the operator's breathing zone. Two sampling pumps will be utilized – a high volume pump and a low volume pump – thus, two filters will be collected for each sampling period (i.e., a high volume filter and a low volume filter).

During the site preparation activity, one operator will utilize a machine to remove brush and tree litter from the area. The operator will continue this process until the landing area has been cleared and the road restored to its original condition. Air sampling cassettes will be changed out every 2 hours.

This page intentionally left blank to facilitate double-sided printing

APPENDIX C

STANDARD OPERATING PROCEDURES**

SOP ID	SOP Description
OU3 No. 7	Equipment Decontamination
OU3 No. 8	Sample Handling and Shipping
OU3 No. 9	Field Documentation
OU3 No. 11	GPS Data Collection
OU3 No. 12	Investigation Derived Waste (IDW) Management
EPA-LIBBY-2012-12	Sampling and Analysis of Tree Bark for Asbestos
EPA-LIBBY-2012-11	Sampling and Analysis of Duff for Asbestos
ABS-LIBBY-OU3	Activity-based Sampling for Asbestos
EPA-LIBBY-08	Indirect Preparation of Air and Dust Samples for TEM Analysis
EPA-LIBBY-09	SOP for TEM Data Review and Data Entry Verification
EPA-LIBBY-11	SOP for FSDS Data Review and Data Entry Verification

***The most recent versions of field SOPs are provided electronically in the OU3 eRoom (https://team.cdm.com/eRoom/mt/LibbyOU3). The most recent versions of laboratory and data verification SOPs are provided electronically in the Libby Lab eRoom (https://team.cdm.com/eRoom/mt/LibbyLab).*

This page intentionally left blank to facilitate double-sided printing

APPENDIX D
DECONTAMINATION CHECKLIST FOR VEHICLES AND HEAVY EQUIPMENT

Libby Asbestos Project Equipment Decontamination Checklist

Date:			Site Location:	
Removal Contractor :			Owner of Equipment:	
Type of Equipment:			Odometer or Hour Meter :	
Equipment Identification Number:			USACE pre-notification:	
Purpose of Decontamination	**Check One**	**Air Filtration Units**	**Yes/NA**	**Parts Number**
End of Service		Cab Filter Replaced		
Change of Duty		Engine Intake Filter Replaced		
Repairs		Main HEPA Filter Replaced		
Other:		Prefilter on HEPA Replaced		
General Requirements	**Yes/NA**	**Water Truck (Mine Use)**	**Yes/NA**	
Remove All Protective Plating		Flush Water Delivery System	Number of Times:	
Pressurize Wash All Surfaces		Water System Sampled		
Wash Engine Compartment		Non-detect Sample Results		
Remove All Floor Mats		**Industrial Vacuum**		
Wet Wipe/ HEPA Vac Interior		Hopper Decontamination		
Comments:				
Filter Disposal Information:				

Sign below when the full decontamination has been performed per the RAWP standard.

Form Completed by:	Signed:		Date
RC Inspection Performed by :	Signed:		Date
TQA Inspection Performed by:	Signed:		Date
USACE Completion Notification:	Rep:	Time:	Date:

This page intentionally left blank to facilitate double-sided printing

APPENDIX E

FIELD SAMPLE DATA SHEETS (FSDSs)**
FOR THE COMMERCIAL LOGGING ABS

***The most recent versions of FSDS forms are provided electronically in the OU3 eRoom (https://team.cdm.com/eRoom/mt/LibbyOU3).*

This page intentionally left blank to facilitate double-sided printing

APPENDIX F

CHAIN OF CUSTODY (COC) FORMS**
FOR THE COMMERCIAL LOGGING ABS

***The most recent versions of COC forms are provided electronically in the OU3 eRoom (https://team.cdm.com/eRoom/mt/LibbyOU3).*

This page intentionally left blank to facilitate double-sided printing

APPENDIX G

ANALYTICAL REQUIREMENTS SUMMARY SHEET

[OU3LOG-0812]

SAP/QAPP REQUIREMENTS SUMMARY #LOGOU3-0812
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

Title: Libby Asbestos Site, OU, Sampling and Analysis Plan/Quality Assurance Project Plan, 2012 Commercial Logging Activity-Based Sampling

SAP Date (Revision): August 2012 (Revision 0)

EPA Technical Advisor: Christina Progess (303-312-6009, Progess.Christina@epa.gov)
(contact to advise on DQOs of SAP related to preparation/analytical requirements)

Sampling Program Overview: This program will conduct activity-based sampling in OU3 during commercial logging operations. As part of this program, ABS air samples will be collected during authentic commercial logging operations and analyzed by TEM. Prior to the ABS effort, duff and tree bark will be collected from the ABS area. Duff material samples will be collected and analyzed for asbestos by TEM (following preparation by SOP EPA-LIBBY-2012-12). Tree bark samples will be collected and analyzed for asbestos by TEM (following preparation by SOP EPA-LIBBY-2012-12).

Estimated number and timing of field samples (does not include field QC):

>> Duff (~August/September): 5 samples
>> Tree Bark (~August/September): 5 samples
>> ABS Air (~August/September): 10-20 samples (estimate; actual number will depend upon number of participants and logging duration)

Sample ID Prefix: CL-3 _ _ _ _

1. ABS AIR

TEM Preparation and Analytical Requirements for Air Field Samples:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? [a,b] With Ashing	Indirect Prep? [a,b] Without Ashing	Filter Archive?	Method	Recording Rules [c]	Analytical Sensitivity/Prioritized Stopping Rules	
A	Air, ABS	Yes	Yes, if material is overloaded (>25%) or unevenly loaded on filter	No	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	PCME asbestos; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 0.0018 cc^{-1} is achieved ii) 25 PCME LA structures are recorded iii) 20 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085

[a] The high volume filter will be analyzed in preference to the low volume filter if direct preparation is possible. If the high volume filter is overloaded, use the low volume filter. If the low volume filter is overloaded, prepare indirectly (with ashing), calculate number of grid openings to analyze to reach target analytical sensitivity, and contact EPA project managers or their designate before proceeding with analysis.
[b] See most current version of SOP EPA-LIBBY-08 for indirect preparation details.
[c] Data recording for chrysotile is not necessary, but the presence of chrysotile should be noted in analysis comments.

TEM Preparation and Analytical Requirements for Air Field Quality Control Samples:

Medium Code	Medium, Sample Type	Preparation Details			Analysis Details			Applicable Laboratory Modifications (current version of)
		Indirect Prep?		Archive?	Method	Recording Rules	Stopping Rules	
		With Ashing	Without Ashing					
B	Air, lot blank and field blank	No	No	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	PCME asbestos; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Examine 1.0 mm^2 of filter.	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085

2. DUFF MATERIAL

TEM Preparation and Analysis Requirements for Duff Samples:

Medium Code	Medium, Sample Type	Preparation Details [d]				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep?		Filter Archive?	Method	Recording Rules	Analytical Sensitivity/ Prioritized Stopping Rules	
			With Ashing	Without Ashing					
C	Duff, Filter	Yes	Yes	No	Yes	TEM – Modified ISO 10312 (see Section 6.2 of SOP DUFF-LIBBY-OU3)	All asbestos; L: ≥ 0.5 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 1E+07 g^{-1} is achieved ii) 50 LA structures are recorded iii) 1.0 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085

[d] Prepare samples in accordance with the procedures in SOP EPA-LIBBY-2012-12 (see Section 6). Any remaining ash material should be archived for possible future analysis.

3. TREE BARK

TEM Preparation and Analysis Requirements for Tree Bark Samples:

Medium Code	Medium, Sample Type	Preparation Details [e]				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? With Ashing	Indirect Prep? Without Ashing	Filter Archive?	Method	Recording Rules	Analytical Sensitivity/ Prioritized Stopping Rules	
D	Tree Bark, Filter	Yes	Yes	No	Yes	TEM – Modified ISO 10312 (see Section 6.2 of SOP TREE-LIBBY-OU3)	All asbestos; L: $\geq$ 0.5 µm AR: $\geq$ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) sensitivity of 100,00 cm^{-2} is achieved ii) 50 LA structures are recorded iii) 1.0 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085

[e] Prepare samples in accordance with the procedures in SOP EPA-LIBBY-2012-11 (see Section 6). Any remaining ash material should be archived for possible future analysis.

Analytical Laboratory Quality Control Sample Frequencies:

TEM [f]: Lab Blank – 4%
Recount Same – 1%
Verified Analysis – 1%
Repreparation – 4%
Recount Different – 2.5%
Inter-laboratory – 2% [g]

Addtl TEM, for tree bark:
Filtration Blank – 2%
Laboratory Duplicate – 5% [h]

Addtl TEM, for duff:
Drying Blank – 1 per batch
Filtration Blank – 2%
Laboratory Duplicate – 5% [h]

[f] See LB-000029 for selection procedure and QC acceptance criteria.
[g] *Post hoc* selection to be performed by the QATS contractor.
[h] Laboratory duplicates are filters created by preparing a new aliquot of the ash residue.

Requirements Revision:

Revision #:	Effective Date:	Revision Description
0	7/31/2012	---
1	8/3/2012	Changed duff/tree bark preparation to archive ash (not replicate filters).

Analytical Laboratory Review Sign-off:

☒ EMSL – Libby [sign & date: R.K. Mahoney 1 August 2012]
☒ EMSL – Cinnaminson [sign & date: R. Denton 08/08/12]
☒ MAS [sign & date: ___Michael D. Mount, 08/07/12]

☒ ESAT [sign & date: __ Douglas_Kent_1_August_2012____]

[Checking the box and initialing above indicates that the laboratory has reviewed and acknowledged the preparation and analytical requirements associated with the specified SAP.]

This page intentionally left blank to facilitate double-sided printing

APPENDIX H

RECORD OF MODIFICATION FORMS

This page intentionally left blank to facilitate double-sided printing

FIELD MODIFICATION APPROVAL FORM
LFM-OU3-xx
Libby OU3 Commercial Logging SAP/QAPP

Requested by: ______________________ Date: ______________

Description of Deviation:

☐ EPA Region 8 has reviewed this field modification approves as proposed.

☐ EPA Region 8 has reviewed this field modification and approves with the following exceptions:

☐ EPA Region 8 has reviewed this field modification and does not agree with the proposed approach for the following reasons:

Christina Progess, EPA RPM

Date

This page intentionally left blank to facilitate double-sided printing

Request for Modification
to
Laboratory Activities
LB-0000XX

Instructions to Requester: E-mail form to contacts at bottom of form for review and approval.
All Labs Applicable Forms – copies to: EPA LC, QATS contractor, All Project Labs
Individual Labs Applicable Forms – copies to: EPA LC, QATS contractor, Initiating Lab

Method (circle all applicable):			
	TEM-AHERA	TEM-ISO 10312	PCM-NIOSH 7400
EPA/600/R-93/116	ASTM 5755	TEM 100.2	SRC-LIBBY-03
SRC-LIBBY-01	NIOSH 9002	Other:______________________	

Requester:______________________________ Title: ______________________
Company: ______________________________ Date: ______________________

Original Requester: ______________________ Original Request Date: ____________
[only applicable if modification is a revision of an earlier modification]

Description of Modification:
____

Reason for Modification:
____

Potential Implications of this Modification:
____

Laboratory Applicability (circle one): **All** **Individual(s)** ______________________

This laboratory modification is (circle one): **NEW** **APPENDS to** ___________ **SUPERCEDES** ___________

Duration of Modification (circle one):
Temporary Date(s): ______________________
Analytical Batch ID: ______________________
Temporary Modification Forms – Attach legible copies of approved form with all associated raw data packages

Permanent (Complete Proposed Modification Section) Effective Date: ______________

Permanent Modification Forms – Maintain legible copies of approved form in a binder that can be accessed by analysts.

Proposed Modification to Method (attach additional sheets if necessary; state section and page numbers of method when applicable):
____

REFERENCES

Data Quality Indicator (circle one) – Please reference definitions below for direction on selecting data quality indicators:

Not Applicable **Reject** **Low Bias** **Estimate** **High Bias** **No Bias**

DATA QUALITY INDICATOR DEFINITIONS:

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely affect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

Technical Review: ______________________________ Date: __________
(Laboratory Manager or designate)

Project Review and Approval: ______________________________ Date: __________
(USEPA: Project Manager or designate)

Approved By: ______________________________ Date: __________
(USEPA: Technical Assistance Unit Chief or designate)

APPENDIX I

ASBESTOS LABORATORY ACCEPTANCE CRITERIA

FOR LIBBY ASBESTOS SUPERFUND SITE

MINIMUM LABORATORY ACCEPTANCE CRITERIA

1. Must be certified by the National Institute of Standards and Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP) for the analysis of asbestos by PLM[10] and/or TEM[11].

2. Must have a laboratory-specific Quality Management Plan and all relevant SOPs in place for asbestos environmental sample processing and analysis.

3. Must have multiple experienced analysts on staff capable of running PLM visual area estimation methods [NIOSH 9002, EPA 600] and/or TEM methods [ISO 10312, ISO 13794, AHERA, ASTM 5755, EPA Method 100.2] (a minimum of 2 analysts within each laboratory are needed to assess within-laboratory reproducibility). Must have documentation in place demonstrating all analysts work experience and training related to analyses performed.

4. Must be familiar with standard TEM and PLM preparation methods. TEM laboratories must have ability to perform indirect preparation and ashing (for the analysis of air, dust, other media) and/or ozonation/UV/sonication treatment (for the analysis water). PLM laboratories must have the ability to dry samples (for PLM-NIOSH 9002 analysis). If the PLM laboratory wishes to perform soil sample preparation in support of the Libby-specific PLM methods (i.e., PLM-VE and PLM-Grav), the laboratory must have the ability to sieve and grind soil samples in accordance with the Libby-specific preparation method.

> Note: Not all laboratory facilities need to have all preparation capabilities; media analysis could be segregated based on facility capability (i.e. one laboratory does water, another does soil, etc.).

5. TEM laboratories must have Energy Dispersive Spectroscopy (EDS) and Selected Area Electron Diffraction (SAED) capability incorporated into their microscope(s).

6. Must participate in monthly EPA laboratory calls for the Libby project.

7. Must participate in inter-laboratory analyses with other Libby project laboratories.

8. Must participate in annual EPA (QATS) audits and in other laboratory and/or data audits if data quality issues arise, as deemed appropriate by EPA.

9. Must be capable of using Libby-specific bench sheets to record observations and utilizing Libby-specific electronic data deliverables (EDDs) to report analytical results.

10. Must have the capacity to meet the required delivery schedules and turn-around times.

11. Must designate laboratory primary and secondary points of contact for discussion of EPA/laboratory issues.

---

[10] http://www.nist.gov/nvlap/upload/NIST-HB-150-3-2006-1.pdf
[11] http://www.nist.gov/nvlap/upload/NIST-HB-150-13-2006-1.pdf

EPA APPROVAL PROCESS

1. Once potential laboratories are identified that meet the minimum acceptance criteria, they must show proficiency in analysis of NIST/NVLAP performance evaluation samples and inter-laboratory samples (standard PLM visual area estimation and TEM only, no Libby-specific method modifications and requirements).

2. If proficiency is documented, an EPA (QATS) audit will be performed.

3. If any deficiencies found during the audit are sufficiently resolved to EPA's satisfaction, then project-specific mentoring will be conducted to ensure laboratories are proficient in the Libby-specific methods, modifications, and requirements.

4. Once a laboratory has passed all of these steps, EPA will approve the use of the laboratory and documentation to this effect will be sent to the laboratory. Samples can then be sent to the laboratory for analysis.